TM 11-1367

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATOR'S AND ORGANIZATIONAL MAINTENANCE RADAR SET AN/MPQ-4A

HEADQUARTERS, DEPARTMENT OF THE ARMY

APRIL 1958

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 440-volt plate and power supply circuits, or on the 120-volt ac line connections.

DON'T TAKE CHANCES!

EXTREMELY HIGH VOLTAGES

EXIST IN THE FOLLOWING UNITS:

Duplexer TR tube assembly	700-volts
Power Supply PP–1588/MPQ–4A	700-volts
Azimuth and Range Indicator IP–375/MPQ–4A	14,000-volts
Modulator transmitter	26,000-volts

GASOLINE HANDLING

Do not refuel the power unit and do not handle or leave open gasoline containers or plastic gasoline containers in the vicinity of the radar set while the radar transmitter is on.

RF BURNS

Do not stand in the path of radiation from the radar set while the radar transmitter is on.

RADIATION HAZARD

Tube type OB2WA is used in this radar set and contains a small amount of radioactive material. This tube is potentially hazardous when broken. Contact qualified medical personnel immediately in case of an accidental cut. For further instructions refer to TB SIG 225.

TECHNICAL MANUAL
No. 11-1367

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *14 April 1958*

RADAR SET AN/MPQ-4A

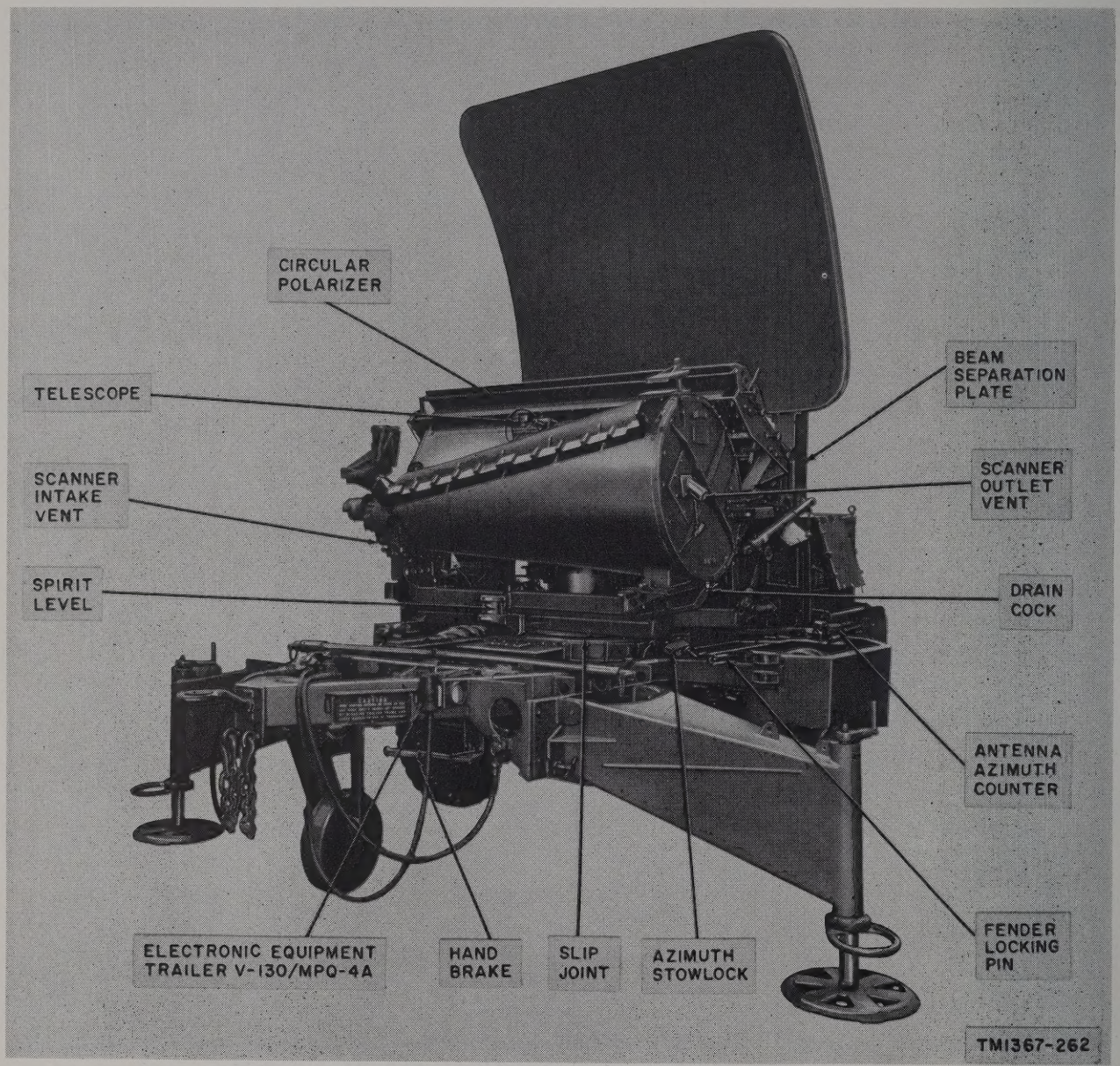


Figure 1. Radar Set AN/MPQ–4A (control-indicator group and power unit not shown).

CHAPTER 1
INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, and organizational maintenance of Radar Set AN/MPQ–4A (fig. 1). It presents an explanation of the chief functions of each major group of components but does not include a discussion of circuit theory.

b. Forward comments on this manual directly to Commanding Officer, United States Army Signal Publications Agency, Fort Monmouth, N.J.

2. Forms and Records

a. Unsatisfactory Equipment Report. Fill out and forward DA Form 468, Unsatisfactory Equipment Report, to Command Officer, United States Army Signal Equipment Support Agency, Fort Monmouth, N.J., as prescribed in AR 700–38.

b. Damaged or Improper Shipment Report. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army).

c. Preventive Maintenance Form. Prepare DA Form 11–238 (Maintenance Check List For Signal Equipment (Sound Equipment, Radio, Direction Finding, Radar, Carrier, Radiosonde and Television)) in accordance with instructions on the form (fig. 33).

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Radar Set AN/MPQ–4A (fig. 1) is a mobile, low-range radar system used to determine the location of enemy mortars or low-velocity artillery. The radar set is powered by Gasoline Engine Generator Set PU–107A/U, which is mounted on a trailer. Provision is made for local or remote operation. The radar set operates in the 16,000-megacycle frequency (K_U) band. The operating components of the AN/MPQ–4A are shown in figure 2. The functions of the radar set are as follows:

a. Searching. The radar set is used as a sector search set to intercept the flight path of a low-velocity projectile (target) having a minimum caliber of 60 millimeter (mm). Targets are detected and displayed on a B-scope. Accuracy of weapon location is designed to be approximately ±50 meters for 80 percent of all locations made with the lower beam tilted 50 mils to the horizontal and with the shell origin on the horizontal plane.

b. Detecting. The radar set detects or intercepts a projectile and provides accurate information as to its origin in range (distance) and azimuth (direction). The radar set also supplies the easting and northing coordinates of the weapon position. This data may be used for the following purposes:

(1) To determine the location of hidden enemy mortars or low-velocity artillery pieces.

(2) To determine the impact point of friendly (outgoing) mortar fire.

(3) To determine the impact point of enemy (incoming) mortar fire.

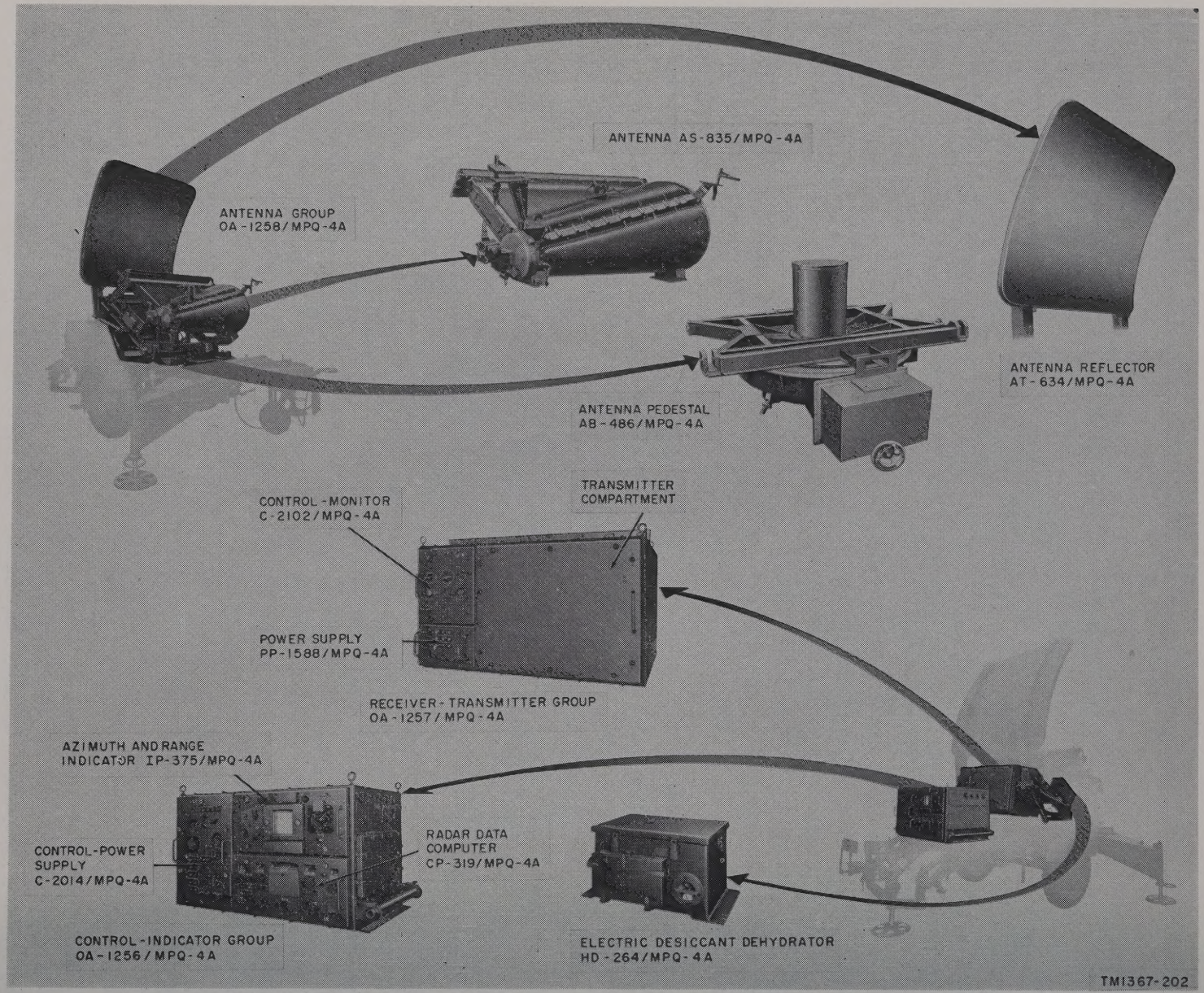


Figure 2. Radar Set AN/MPQ–4A, operating components.

4. Technical Characteristics

a. General.

Range:
- Maximum: 10,000 meters.
- Minimum: 170 meters.
- Accuracy: ±10 meters.
- Resolution: 50 meters.
- Determination: By accurate timing sweep and range strobe (calibrated with crystal delay line).

Azimuth:
- Coverage: 450 mil fixed sector scanning; antenna will fix through 6,400 mils.
- Accuracy: ±1.5 mils.
- Determination: By mechanically driven marker coil and magnet in scanner.

Elevation (beam):
- Coverage: −100 mils to +200 mils.
- Accuracy: ±1 mil.
- Determination: Calibrated antenna elevation synchro varies as the elevation of the fixed beam.

Shelter:
- Size: 51.5 inches deep, 82 inches wide, 50–99 inches high.
- Material: Canvas.
- Use: Operators.

Assembly time: 15 to 30 minutes by a crew of 4 trained men.

b. Transmitting System.

Frequency: 16,000 megacycles per second +160 mc (K_U band).
Wave length: 1.875 centimeters.
Peak power: 50 kilowatts minimum.
Average power: 95 watts.
Pulse repetition rate: 8.,600 cycles per second.
Pulse width: 0.25 microsecond.
Duty cycle: 0.00215.
Source of RF power: Magnetron (tube QK–324).

c. RF System.

Transmission line: K_U band waveguide.
Radiating element: Line source horn.
Reflector: Aluminum parabolic cylinder.
Horizontal beam width: 17.8 mils.
Vertical beam width: 14.25 mils.
Number of beams: Two.
Vertical beam separation: 36 mils.
Type of scan: Foster, dual beam.
Attenuation of lobes: 18 db.
Scanning rate: 17 scans per second.

Duplexer:
- Type: Short slot hybrid.
- Tr tubes: One dual tube, type BL–35.
- Anti-transmit-receive tubes: None.

d. Receiving System.

Type: Linear log (superheterodyne).
Operating frequency: 16,000 mc (K_U band).
Local oscillator: Klystron (tube VA–94B).
Local oscillator frequency: 15,970 mc ±160 mc.
Crystals: 3 (type 1N78A).
Intermediate frequency: 30 mc.
Bandwidth: 5 mc.
Sensitivity: 96 dbm.
Input impedance: 400 ohms (approx).
Maximum gain: 110 db.

e. Synchronizing System.

Master oscillator: Hartley oscillator in indicator.
Marker oscillators: None.
System triggers: Modulator trigger generator in indicator.

f. Indicating System.

Presentation: B-scope.
Indicator (crt): 5½-inch electromagnetic deflection, type K–1413P7, metallized cathoderay tube.
Indicator high voltage: 14,000 volts.
Echo interpretation: Two intensified dots.
Sweep ranges: 0 to 10,000 meters; 2,500 meters (delayed).
Range markers: 0, 2,000, 4,000, 6,000, 8,000, and 10,000 meters.

g. Computing System.

Type: Analog.
Limits of operation:
- Range: 10,160 meters.
- Elevation: −100 to +200 mils.

Present altitude: ±9,999 meters.
Present azimuth: 0 to 6,400 mils.
Present elevation: −100 to +200 mils.
Present slant range: 10,000 meters.
Easting coordinate: 0–11,000 meters.
Northing coordinate: 0–11,000 meters.

h. Antenna Positioning System.

Azimuth:
- Drive system: Ac motor driven.
- Types of operation: Manual or motor driven.
- Continuous rotation speed: 1–2 rpm through 6,400 mils.

Elevation:
- Drive system: Ac motor driven.
- Type of operation: Motor driven.

i. Power Unit.

Type: Gasoline engine driven.
Output: 208/120 volts, 400 cps, Wye connected, 3 phase.
Fuel consumption: 2.5 gallons per hour.

5. Components

(figs. 2 and 6)

a. Equipment Components. The weights and dimensions of the components of Radar Set AN/MPQ–4A are listed in the following chart. The running spares supplied with the radar set are listed in *b* below.

Quantity	Component	Depth (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Unit weight (lb)
1	Antenna Group OA–1258/MPQ–4A consisting of:	66	90.53	66.5[a]	230	1,938
1	Antenna AS–835/MPQ–4A	34 OD (large end)	66	15 od (small end)	20.7	1,109
1	Circular Polarizer MX–2219/MPQ–4A	15	76	13	8.5	39
1	Antenna Pedestal AB–486/MPQ–4A	48	42	19.5	22.8	546
1	Antenna Reflector AT–634/MPQ–4A	2.5	90.53	66.5	8.7	283
1	Tuned Cavity FR–111/MPQ–4A	4.5	5.66	9.62	.14	10
1	Control-Indicator Group OA–1256/MPQ–4A, consisting of:	31.34	53.12	28.42	26.5	571
1	Radar Data Computer CP–319/MPQ–4A	26	20	12	3.6	120
1	Control-Power Supply C–2014/MPQ–4A	17.12	16.60	24.34	4	111
1	Azimuth and Range Indicator IP–375/MPQ–4A	25.78	12.25	23.87	4.37	100
1	Directional Coupler CU–399/MPQ–4	5	2.63	2.13	.016	2
1	Electric Desiccant Dehydrator HD–264/MPQ–4A	24	9	10	1.25	45
1	Trailer Mounted Gasoline Engine Generator Set PU–304A/MPQ–4, consisting of:	165.5	83	98	779	2,650
1	Gasoline Engine Generator Set PU–107A/U	48	28	37	28.8	1,225
1	Trailer, M105A2 (modified).					
1	Receiver-Transmitter Group OA–1257/MPQ–4A, consisting of:	30.28	49.32	29.5	25.5	560
1	Intermediate Frequency Amplifier AM–1538/MPQ–4A	19.5	2.5	2	.056	4
1	Trigger Pulse Amplifier AM–1537/MPQ–4A	18.62	5.22	8.30	.47	13
1	Control-Monitor C–2102/MPQ–4A[b].					
1	Receiver Control C–2016/MPQ–4A	9.50	5.38	5.10	.15	4
1	Receiver Control C–2015/MPQ–4A	10.68	3.38	3.72	.078	2
1	Duplexer CU–476/MPQ–4A	6	6.56	5	.113	4
1	Power Supply PP–1588/MPQ–4A	24	8.30	14.10	1.62	46.5
1	Cable Reel RC–413/MPQ–4	28	12	28	5.4	14
1	Cable Reel RC–419/MPQ–4	36	30.5	36	22.8	30
1	Electrical Equipment Shelter S–134/MPQ–4A consisting of:	51.5[c]	41[c]	13[c]	15.8	175
1	Shelter Intake Blower Assembly HD–279/MPQ–4A	15.10	11.62	11.62	1.18	20
1	Shelter Blower Assembly Exhaust HD–278/MPQ–4A	15.10	11.62	11.62	1.18	20
2	Spare Parts Chest CY–2201/MPQ–4A	23.38	26.88	19.88	7.24	85
1	Control-Indicator Stand MT–1733/MPQ–4A	48.76	24.5	7.75[d]	5.35	15
2	Operator's Seat Support MT–1798/MPQ–4A	7.5	7.5	20.5	.667	12
1	Electronic Equipment Trailer V–130/MPQ–4A	192	96	36.75	392	1,858
	One set of running spares (*b* below).					
	Total					11,572.5

[a] Height is 66.5 inches with reflector down, 122.5 inches with reflector up.
[b] Part of receiver compartment door.
[c] Folded dimensions. Shelter is 51.5 inches deep, 82 inches wide, and 50–99 inches high (adjustable) when assembled.
[d] Height is 7.75 inches folded, 31 inches standing.

b. Running Spares. The following running spares, stored in two Spare Parts Chests CY–2201/MPQ–4A, are supplied with Radar Set AN/MPQ–4A. Spares are supplied for all normally expendable items such as tubes, pilot lamps, crystals, and fuses.

Quantity	Item
2	Desiccant chanber M-18622D
5	Cartridge fuses B2R78P3
5	Cartridge fuses B2R78P4
5	Cartridge fuses B2R78P5
3	Cartridge fuses B2R79P8
5	Cartridge fuses B2R83P33
5	Cartridge fuses K7878690P1
5	Cartridge fuses B2R78P7
3	Cartridge fuses B2R79P3
5	Cartridge fuses B2R79P5
3	Glow lamps NE51
4	Incandescent Mazda lamps No. 44
4	Incandescent lamps GE No. 1251
1	Incandescent lamp GE No. 1683
1	Incandescent lamp GE 10C7/DC
2	Incandescent Mazda lamps No. 47
1	Incandescent Mazda lamp No. 325
12	Marking Dixon pencils No. 92 (white)
1	Plug-in relay SMC110079P1
1	Plug-in relay SMC110079P2
1	Plug-in relay C7709993P3
1	Plug-in relay C7713323P4
1	Plug-in relay C7713323P5
1	Semiconductor device, diode 1N78A
1	Semiconductor device, diode 1N78
1	Magnetron tube, QK-324
1	Tube, BL-35
1	Tube, OB2WA
4	Tubes, 5R4WGA
1	Tube, 6AH6
5	Tubes, 6AU6WA
6	Tubes, 12AT7WA
2	Tubes, 577
2	Tubes, 5687
3	Tubes, 5726/6AL5W
3	Tubes, 5751
1	Tube, 5842
2	Tubes, 5933
1	Tube, K–1413P7
1	Tube, VA–94B
1	Tube, 6130
1	Tube, 6L6WGB
3	Tubes, 5654/6AK5W
2	Tubes, 5725/6AS6W
1	Tube, 5814A
1	Tube, 5949A
1	Tube, 5749/6BA6W
2	Tubes, 6005/6AQ5W
1	Tube, 6080WA
1	Tube, 6336A

6. Common Names

A list of nomenclature and common name assignments for Radar Set AN/MPQ–4A and its major components is given below.

Nomenclature	Common name
Radar Set AN/MPQ–4A	Radar set
Intermediate Frequency Amplifier AM-1538/MPQ–4A.	IF amplifier
Trigger Pulse Amplifier AM–1537/MPQ–4A.	Trigger amplifier
Antenna AS–835/MPQ–4A	Scanner
Antenna Group OA-1258/MPQ–4A	Antenna group
Shelter Intake Blower Assembly HD–279/MPQ–4A.	Shelter intake blower
Shelter Exhaust Blower Assembly HD–278/MPQ–4A.	Shelter exhaust blower
Tuned Cavity FR–111/MPQ–4A	Echo box
Circular Polarizer MX–2219/MPQ–4A.	Circular polarizer
Radar Data Computer CP–319/MPQ–4A.	Computer
Control-Indicator Group OA–1256/MPQ–4A.	Control-indicator group
Control-Monitor C–2102/MPQ–4A	Control-monitor
Control-Power Supply C–2014/MPQ–4A.	Control-power supply
Receiver Control C–2016/MPQ–4A	Afc assembly
Receiver Control C–2015/MPQ–4A	Stc assembly
Directional Coupler CU–399/MPQ–4	Directional coupler
Electric Desiccant Dehydrator HD–264/MPQ–4A.	Dehydrator
Duplexer CU–476/MPQ–4A	Duplexer
Trailer Mounted Gasoline Engine Generator Set PU–304A/MPQ–4.	Power unit
Azimuth and Range Indicator IP–375/MPQ–4A.	Indicator
Antenna Pedestal AB–486/MPQ–4A	Pedestal
Power Supply PP–1588/MPQ–4A	Low-voltage power supply
Receiver-Transmitter Group OA–1257/MPQ–4A.	Receiver-transmitter group
Cable Reel RC–413/MPQ–4	Power cable reel
Cable Reel RC–419/MPQ–4	Remote cable reel
Antenna Reflector AT–634/MPQ–4A	Reflector
Electrical Equipment Shelter S–134/MPQ–4A.	Operator's shelter
Control-Indicator Stand MT–1733/MPQ–4A.	Remoting stand
Operator's Seat Support MT–1798/MPQ–4A.	Remoting seat support
Electronic Equipment Trailer V–130/MPQ–4A.	Radar trailer
Electrical Power Cable Assembly CX–277/U (101 ft 0 in.)	W701
Electrical Special Purpose Cable Assembly CX–3898/U (6 ft 8 in.).	W702
Electrical Special Purpose Cable Assembly CX–4103/U (150 ft 0 in.).	W703

Nomenclature	Common name
Electrical Power Cable Assembly CX–3904/U (3 ft 0 in.) (2 ea).	W704, W708
Radio Frequency Cable Assembly CG–783A/U (3 ft 0 in.) (4 ea).	W705, 706, W707 and W741
Electrical Power Cable Assembly CX–3902/U (3 ft 0 in.).	W709
Electrical Power Cable Assembly CX–3905/U (6 ft 6 in.).	W710
Electrical Power Cable Assembly CX–3900/U (3 ft 0 in.).	W711
Electrical Power Cable Assembly CX–4062/U (4 ft 6 in.).	W716
Electrical Power Cable Assembly CX–3902/U (4 ft 0 in.).	W717
Electrical Power Cable Assembly CX–4104/U (4 ft 0 in.).	W718
Electrical Power Cable Assembly CX–4016/U (3 ft 9 in.).	W719
Electrical Power Cable Assembly CX–4015/U (5 ft 2 in.).	W720
Electrical Power Cable Assembly CX–4010/U (2 ft 0 in.).	W721
Electrical Power Cable Assembly CX–3901/U (6 ft 8 in.).	W722
Electrical Special Purpose Cable Assembly CX–4012/U (1 ft 2 in.).	W723
Electrical Power Cable Assembly CX–4009/U (2 ft 6 in.).	W724
Electrical Power Cable Assembly CX–4013/U (4 ft 2 in.).	W725
Electrical Power Cable Assembly CX–4011/U (6 ft 0 in.).	W726
Electrical Power Cable Assembly CX–4014/U (3 ft 0 in.) (2 ea).	W728 and W729
Electrical Power Cable Assembly CX–3903/U (1 ft 10 in.).	W730

7. Description of Receiver-Transmitter Group OA–1257/MPQ–4A (fig. 2)

The receiver-transmitter group contains the modulator, transmitter, trigger amplifier, duplexer, two receiver controls (automatic frequency control and sensitivity time control assemblies), intermediate-frequency amplifier, control-monitor, and a low-voltage power supply.

a. Receiver-Transmitter Cabinet. The receiver-transmitter cabinet consists of a receiver compartment with the control-monitor mounted on its door, a transmitter compartment with the relay chassis mounted on its door, and a removable drawer which contains the low-voltage power supply. The compartments are all interlocked, so that power is removed when any door or drawer is opened. Interlock shorting switches are provided for each interlock and are off when the doors and drawer are firmly closed. Each door and drawer is secured with pawl fasteners located on the front panels. Two blowers located at the rear of the cabinet provide ventilation for the receiver and modulator circuits and for the magnetron. An air intake panel and an air exhaust panel are provided at the rear of the cabinet, with a second air exhaust panel on the left-hand side of the cabinet. These panels are interlocked and must be opened to permit passage of air, or the equipment will not operate.

b. Modulator and Transmitter. The modulator and transmitter are located in the transmitter compartment, which is on the right-hand side of the cabinet (fig. 2). The transmitter consists of magnetron QK–324; the modulator consists of the trigger amplifier (*c* below), high-voltage power supply, hydrogen thyratron, and associated circuitry. The magnetron is secured between two brackets, which are mounted at the top left side of the compartment. The relay chassis for the modulator is mounted at the rear of the transmitter door. The high-voltage transformer is on the right-hand side of the compartment behind the rectifier tubes. The remaining circuit elements are mounted on the bottom, right side, and top of the compartment. A voltmeter and power rheostat are used to adjust the correct operating voltage of the trigger hydrogen thyratron tube. They are secured to a bracket at the top right corner of the compartment.

c. Trigger Pulse Amplifier AM–1537/MPQ–4A (fig. 62). The trigger amplifier is on the left-hand side of the transmitter compartment. It is secured to the floor of the compartment with two thumbscrews, and positioned with two centering pins at the rear of the chassis.

d. Duplexer CU–476/MPQ–4A (fig. 67). The duplexer is mounted in the center of the receiver compartment, which is on the left-hand side of the receiver-transmitter group (fig. 2). It is secured in position by a bracket, waveguide coupling connectors, and connections to the klystron flange. The klystron local-oscillator tube and motor drive is connected to the duplexer in a horizontal position.

e. Receiver Control C–2016/MPQ–4A (fig. 67). The afc assembly is on the left-hand side of the receiver compartment. It is secured to the bottom of the compartment with two thumbscrews, and positioned with two centering pins at the rear of the chassis.

f. Intermediate Frequency Amplifier AM–1538/MPQ–4A (fig. 67). The if amplifier is in the front center of the receiver compartment, immediately to the right of the afc assembly. It is fastened to the bottom of the compartment with two thumbscrews, and positioned with a centering pin at the rear of the chassis.

g. Receiver Control C–2015/MPQ–4A (fig. 67). The stc assembly is mounted on the right-hand side of the receiver compartment. It is secured to the bottom of the compartment with two thumbscrews, and positioned with a centering pin at the rear of the chassis.

h. Control-Monitor C–2102/MPQ–4A (fig. 2). The control-monitor is on the front door of the receiver compartment. It has three meters, a meter selector switch, and two switches for local-oscillator tuning and afc-manual control. There are also four receptacles on the panel for test purposes plus a 120-volt 400-cycle per second convenience outlet.

i. Power Supply PP–1588/MPQ–4A (fig. 2). The low-voltage power supply drawer is located below the receiver compartment. The drawer is mounted on drawer slides and may be fully extended from the cabinet. By releasing catches on each side of the drawer, it can be removed entirely. Three fuses, with adjacent indicator lamps, are mounted to the left of the front panel. There are also three spare fuses located to the right of the indicator lamps.

8. Description of Control-Indicator Group OA–1256/MPQ–4A
(fig. 2)

a. Control-Indicator Cabinet. The control-indicator cabinet consists of three drawer assemblies containing the indicator, computer, and control-power supply. These assemblies are equipped with drawer slides and may be fully extended from the cabinet. All three drawers are interlocked and power is removed when any drawer is opened. Interlock shorting switches for each interlock switch are off when the drawers are firmly closed. Each drawer is secured with pawl fasteners located on the front panels. One blower at the rear of the cabinet circulates cool air. An air intake panel is located on the left-hand side of the cabinet and an air exhaust panel is located on the right-hand side. These panels are interlocked and must be opened to permit passage of air, or the equipment will not operate. Carrying handles, mounted on the sides of the cabinet, are used as a means of transporting the component when remote operation is required.

Warning: Do not extend more than one drawer at a time when the component is remotely operated. The cabinet is heavy and may tip over with all drawers fully extended.

b. Azimuth and Range Indicator IP–375/MPQ–4A (fig. 2). The indicator, located on the top right-hand side of the cabinet in a removable drawer, has three hinged access panels on the top side and two on the bottom side. Openings in the four large panels permit upright components such as tubes, capacitors, and potentiometer shafts, to project through. Two or three assembly boards are mounted beneath each large panel. These assemblies consist of phenolic boards which mount the circuit elements and associated wiring. The 14,000-volt supply for the cathode-ray tube anode is developed by a rectifier-voltage multiplier circuit located on the center bottom of the cabinet. A reflection plotter assembly is mounted on the center of the front panel, directly in front of the crt. The panel also contains two range selector switches, a video beam selector switch, two timer buttons, a time indicator, a reset switch for the timer, and a lamp which indicates that the computer controls are not set in detent. Other adjustment controls are concealed behind hinged covers mounted above and below the reflection plotter.

c. Radar Data Computer CP–319/MPQ–4A (fig. 2). The computer is housed in a removable drawer directly below the indicator. Six electrical plug-in subassemblies are mounted on a hinged panel in the top section of the drawer. They include four dual servo amplifiers, one booster and dual speed cutover amplifier, and one dual isolation amplifier. Directly underneath are eight magnetic amplifiers. Behind the front panel are the eight servo and gear-train subassemblies: range, azimuth, *C*, time,

height, elevation, and coordinate subassemblies (two). Their counters are visible on the front panel. The radar location and radar height counters are covered with hinged panels when not in use. The six control knobs on the front panel are used to manually set into the computer the information derived from the indicator.

d. Control-Power Supply C–2014/MPQ–4A (fig. 2). The control-power supply is in a removable drawer on the left-hand side of the control-indicator cabinet. It consists of two chassis which are mounted vertically back to back and at right angles to the control panel. The chassis on the left-hand side is hinged at the rear of the drawer. Thus, it may be swung out to provide access to the back portions of both chassis, since the chassis on the right is fixed in position. The control panel is hinged on the bottom and may be swung down for maintenance purposes. The upper right-hand corner of the front panel mounts the controls for operating the remote power unit, starting or stopping the equipment, and applying power to all assemblies. Directly above these controls are four panel lamps which indicate proper operation. Two meters with associated selector switches are provided for voltage and current checks. Seven fuses are mounted on the lower portion of the control panel, with an indicator lamp and a spare fuse located to the left of each fuse. Four other blown fuse indicator lamps are used for fuses mounted at the rear of the control panel.

9. Description of Antenna Group OA–1258/MPQ–4A (fig. 2)

a. Antenna Pedestal AB–486/MPQ–4A (fig. 2). The pedestal consists of a stationary lower portion which is secured to the radar trailer chassis, and a rotating upper section upon which the reflector and scanner are mounted. The lower portion of the pedestal is suspended on three ball joints, the sockets of which are securely fastened to the radar trailer frame. The main power cable from the control-indicator group mates with a connector on the right-hand side of this lower portion. The azimuth drive motor and azimuth data takeoff synchro are also located in this section of the pedestal. The upper or rotating portion has connectors on the top surface for cabling to the receiver, transmitter, scanner drive motor, reticle lamp control box, elevation actuator motor, and elevation synchro. The rotating portion also contains hinged mountings for the elevation actuators and the reflector support structure. Sliprings provide for transfer of power and signal voltages between the fixed lower section and the movable upper section of the pedestal. The mounting flange of the slipring assembly is mounted on the top surface of the pedestal. An azimuth counter, which counts the number of mils that the upper portion of the pedestal rotates, is attached to the radar trailer chassis. It is used to check the actual azimuth angle of the antenna against the angle shown on the computer. The elevation counter on the antenna supporting structure indicates the elevation of the lower beam.

b. Antenna Reflector AT–634/MPQ–4A (fig. 2). The reflector is mounted on two supporting beams which are fastened to the antenna support structure. This structure, in turn, is attached to a pair of hinged brackets on the rotating upper pedestal. The extreme lower ends of the reflector support beams are secured to the antenna support structure to insure rigid support of the reflector during operation. Two manually operated cranks are used to erect the reflector. Two locking screws mounted on each side of the support structure are used to lock the reflector firmly in position.

c. Antenna AS–835/MPQ–4A (fig. 2). This is a Foster-type scanner which consists of a number of conical castings. The scanner is mounted by means of the lower casting to the upper surface of the antenna support structure, near the point at which the structure is hinged to the rotating upper pedestal. The (RF) signal enters through a section of rectangular waveguide on the outside of the large end bell. The azimuth strobe control, a subassembly of the scanner, is mounted inside the large end bell. This is a motor gear assembly used to position the azimuth marker coil around the inner circumference of the scanner. The subassembly is housed in a metal case and consists of a synchro transmitter, a servo motor, a gear assembly, and an autotransformer. The large end bell also provides means for the accurate positioning of the azimuth trigger coils during field servicing of the scanner. Measurements of the critical

waveguide passageways inside the scanner are made through a small hole on the large bell during field servicing. The scanner drive motor is mounted on the small end bell and is cabled to a connector on the top surface of the rotating pedestal.

10. Description of Electronic Equipment Trailer V–130/MPQ–4A

(fig. 1)

The radar trailer is a two-wheeled trailer used to mount the antenna group, receiver-transmitter group, control-indicator group, and the dehydrator. Three hinged outriggers permit the leveling of the radar trailer to a horizontal plane when the equipment is on a slope. This slope may not exceed a maximum of 90 mils. Two swing-out seat supports are mounted at the rear of the radar trailer for use during operation. The two operators' seats and a spirit level assembly are located at the front end of the trailer. The ground stake is clamped in position immediately forward of the control-indicator cabinet. A standard military-type fire extinguisher is mounted on the curb-side front of the radar trailer. Running lights and operational lights are powered by a cable connected between the trailer and prime mover. The radar trailer is equipped with air-actuated hydraulic-type service brakes which operate by means of an air hose coupling between the trailer and prime mover.

11. Trailer Mounted Gasoline Engine Generator Set PU–304A/MPQ–4

(fig. 6)

The power unit consists of a 1½-ton, two-wheeled trailer Gasoline Engine Generator Set PU–107A/U (par. 12) and a storage place for accessories and spares. The power unit is securely bolted to the floor of the trailer and is operated in that position. Two cable reels, located at the rear of the trailer, mount the power cable and the remote operation cable. The operator's shelter is strapped to brackets on the inside front of the trailer. A spare magnetron is packed in the transit case mounted on the roadside rear of the trailer. Spare parts are carried in the transit case which is placed on top of the magnetron case. The remoting stand is carried on the curb-side of the trailer, and the remoting seat supports are stored near the remoting stand. The two blower transit cases are stowed at the front curb-side of the trailer.

12. Gasoline Engine Generator Set PU–107A/U

(fig. 6)

The PU–107A/U consists of a permanent-magnet type alternator directly coupled to a four-cylinder gasoline engine. The PU–107A/U also includes a direct-current generator and all necessary controls and instruments for regulation of the equipment. A winterization system facilitates the starting of the PU–107A/U in extremely cold temperatures. The PU–107A/U is assembled within a two-part tubular frame structure. The lower frame forms a skid and also shock-mounts the engine and alternator. The upper frame mounts the instrument and control panels. The instrument panel is shock-mounted on the right-hand side of the PU–107A/U and is accessible through a hinged door. Located on the instrument panel are three ammeters, a frequency meter, a voltmeter, and a voltmeter selector switch. Engine instruments include an oil pressure gage, a battery-charging ammeter, and a coolant temperature gage. The operating controls are found below the instrument panel. These controls include toggle switches for starting the equipment, ac and dc circuit breakers, and a duplex output receptacle. Controls for the winterization system include a toggle switch for the heater, an indicator lamp, and a circuit breaker. For use with Radar Set AN/MPQ–4A, the PU–107A/U is secured to the trailer of Trailer Mounted Gasoline Engine Generator Set PU–304A/MPQ–4. Refer to TM 5–5264 for further information.

13. Electric Desiccant Dehydrator HD–264/MPQ–4A

(fig. 2)

The dehydrator is an automatic device which supplies dry air continuously to the waveguide section in Radar Set AN/MPQ–4A. It is a non-regenerative system consisting of a motor-driven compressor, two desiccant chambers, and associated mechanical elements. A pressure gage and dry air indicator are set in a recess on the right-hand side of the front panel. On

the left-hand side of the panel is a ventilator grill for air intake. The grill has a hinged cover which must be raised before the equipment will operate. An air outlet is located on the left-hand side of the rear panel.

14. Minor Components

a. Tuned Cavity FR–111/MPQ–4A (fig. 70). Tuned Cavity FR–111/MPQ–4A is an echo box to be used with the radar set to check radar system performance within the frequency range of 15,800 to 16,200 megacycles per second. It is bracket-mounted on the pedestal and is connected to the directional coupler by a waveguide. A control knob and calibrated scale on the front panel provide for manual tuning. The echo box includes a IN78 crystal, a mircoammeter, and a potentiometer which adjusts meter sensitivity. The complete assembly is inclosed in a metal case with a captive transit cover. The cover contains an azimuth angle versus frequency chart to be used during orientation.

d. Directional Coupler CU–399/MPQ–4. The directional coupler is a special section of waveguide with a frequency range of 15,700 to 16,300 megacycles. It is bidirectional with an attenuation of 20 decibels, and is used to take off a sample of the RF energy in the main waveguide. This RF energy is fed into the echo box through another connection section of waveguide.

c. Circular Polarizer MX–2219/MPQ–4A (fig. 1). The circular polarizer is used during rainy weather to prevent stray reflection from interfering with the projectile signal. It is mounted above the RF output horns on the scanner, and may be retracted and stowed when not in use.

d. Telescope and Clamp Assembly (fig. 1). The telescope is mounted on the top center of the scanner. It is used for azimuth orientation and to insure a clear line-of-sight to target.

15. Accessories (fig. 6)

The following items are provided as accessory equipment with the radar set. They are carried on the trailer of the power unit.

a. Cable Reel RC–413/MPQ–4. This cable reel is used to carry power cable W701 when the equipment is in transit.

b. Cable Reel RC–419/MPQ–4. This cable reel is used to carry remote operation cable W703 when equipment is in transit.

c. Control-Indicator Stand MT–1733/MPQ–4A. The remoting stand is used to mount the control-indicator group during remote operation.

d. Electrical Equipment Shelter S–134/MPQ–4A. The operators' shelter is provided for the operator's use at the control-indicator group during both trailer and remote operation. Components of the operators' shelter include the canvas, equipment picture frame, ground stakes, and web straps. These items are carried in a transit case assembly which is also designed to form the roof and framework of the operator's shelter. Provision is made for mounting the two blower assemblies (carried separately on the power unit), for attaching the canvas to the shelter frame, and for securing the shelter to the control-indicator group. The ground stakes and web straps are used to moor the shelter after assembly is completed. Tool holders are mounted on the wall near the operator to allow ready access to any tools needed for adjustments.

e. Operator's Seat Support MT–1798/MPQ–4A. Two of these supports are supplied. They are used during remote operation, when the two operators' seats on the radar trailer are detached and moved to the remote site.

f. Shelter Intake Blower Assembly HD–279/MPQ–4A. This shelter intake blower is part of the shelter ventilating system and provides a means of air intake and a light for illuminating the shelter.

g. Shelter Exhaust Blower Assembly HD–278/MPQ–4A. This shelter exhaust blower is a part of the shelter ventilating system and provides a means of air exhaust and a light for illuminating the shelter.

16. Cables

a. Electrical Power Cable Assembly CX–277/U (101 ft 0 in.). Cable W701 connects the power unit to the control-indicator group. This is a rubber-covered, 10-conductor cable with male connector P701 on one end and female connector P1001 on the other. The cable is wound on Cable Reel RC–413/MPQ–4 when in transit.

b. Electrical Special Purpose Cable Assembly CX–3898/U (6 ft 8 in.). Cable W702 connects the control-indicator group to the pedestal for trailer operation. It is a rubber-covered, 2.1-inch-od, 52-conductor cable with male connector P1002 on one end and female connector P3010 on the other.

c. Electrical Special Purpose Cable Assembly CX–4103/U (150 ft 0 in.). Cable W703 is connected between W702 and the control-indicator group for remote operation. It is a rubber-covered, 2.1-inch-od, 52-conductor cable with male connector P703 on one end and female connector P704 on the other. The cable is wound on Cable Reel RC–419/MPQ–4 when in transit.

d. Electrical Power Cable Assembly CX–3904/U (3 ft 0 in.). This is a rubber-covered, 14-conductor cable with a male connector on one end and a female connector on the other. Two of these cables are required.

(1) Cable W704, with connectors P2001 and P3001, is connected between the pedestal and the receiver-transmitter group.

(2) Cable W708, with connectors P2002 and P3002, is connected between the pedestal and the receiver-transmitter group.

e. Radio Frequency Cable Assembly CG–783A/U (3 ft 0 in.). This is a synthetic resin-covered, single-conductor coaxial cable, standard type RG–11A/U, with a male connector on each end. Four of these coaxial cables are required.

(1) Modulator trigger cable W705, with connectors P2004 and P3004, connects between the receiver-transmitter group and the pedestal.

(2) Video output cable W706, with connectors P2005 and P3005, connects between the receiver-transmitter group and the pedestal.

(3) Scanner data cable W707, with connectors P2006 and P3006, connects between the receiver-transmitter group and the pedestal.

(4) Pulse output cable W741, with connectors P2008 and P3005, connects between the receiver-transmitter group and the pedestal.

f. Electrical Power Cable Assembly CX–3902/U (3 ft 0 in.). Cable W709, the afc crystal metering cable, is connected between the receiver-transmitter group and the pedestal. This is a rubber-covered, two-conductor cable with female connector P3003 on one end and male connector P2003 on the other.

g. Electrical Power Cable Assembly CX–3905/U (6 ft 6 in.). Cable W710 connects the dehydrator to the receiver-transmitter group. It is a rubber-covered, six-conductor cable with male connector P2012 on one end and female connector P3301 on the other.

h. Electrical Power Cable Assembly CX–3900/U (3 ft 0 in.). Cable W711 connects the overhead lamp assembly (shelter) to the control-indicator cabinet. This is a rubber-covered, two-conductor cable with male connector P1004 on one end and lug terminals on the other.

i. Waveguide Assemblies. There are seven external waveguide assemblies used in coupling between the scanner and the receiver-transmitter group.

(1) Cable W712 is a standard type RG–91/U waveguide with a self-locating cover flange on each end. It connects between the receiver-transmitter group and W713.

(2) Cables W713 and W714 are flexible waveguides which are electrically equivalent to the standard type RG–91/U. Each waveguide is equipped with a UG–541/U choke flange and a UG–419/U cover flange. Cable W713 is connected between W712 and the directional coupler. Cable W714 is connected between the directional coupler and W715.

(3) Cable W715 is a standard type RG–91/U waveguide with a UG–541/U choke flange on one end and a self-locating cover flange on the other. The waveguide connects between W714 and W745.

(4) Cable W743 is a flexible waveguide electrically equivalent to the standard type RG–91/U waveguide. It is equipped with a UG–419/U cover flange on each end. The waveguide connects between the directional coupler and W744.

(5) Cable W744 is a standard type RG–91/U waveguide with a UG–541/U choke flange on each end. It connects between W743 and the echo box.

(6) Cable W745 is a standard type RG–91/U waveguide with a UG–541/U choke flange on one end and a self-locating cover flange on the other. It connects between the scanner and W715.

j. Electrical Power Cable Assembly CX–4062/U (4 ft 6 in.). Cable W716 connects the azimuth strobe control on the scanner to the pedestal. This is a rubber-covered, nine-conductor cable with female connector P3008 on one end and male connector P3203 on the other.

k. Electrical Power Cable Assembly CX–3902/U (4 ft 0 in.). Cable W717 is connected from the scanner to the receiver-transmitter cabinet. This is a rubber-covered, two-conductor cable with female connector P2009 on one end and male connector P3202 on the other.

l. Electrical Power Cable Assembly CX–4104 (4 ft 0 in.). Cable W718 is connected from the receiver-transmitter cabinet to the elevation motor on the pedestal. This is a rubber-covered, six-conductor cable with male connector P2010 on one end and female connector P3012 on the other.

m. Electrical Power Cable Assembly CX–4016/U (3 ft 9 in.). Cable W719 is connected from the pedstal to the elevation synchro on the antenna support structure. It is a rubber-covered, nine-conductor cable with male connector P3013 on one end and female connector P3014 on the other.

n. Electrical Power Cable Assembly CX–4015/U (5 ft 2 in.). Cable W720 is connected from the pedestal to the scanner motor. It is a rubber-covered, three-conductor cable with male connector P3011 on one end and female connector P3201 on the other.

o. Electrical Power Cable Assembly CX–4010/U (2 ft 0 in.). Cable W721 connects between the azimuth stow switch and the pedestal. It is a rubber-covered, two-conductor cable with male connector P3015 on one end and lug terminals on the other.

p. Electrical Power Cable Assembly CX–3901/U (6 ft 8 in.). Cable W722 connects the reticle lamp control to the receiver-transmitter cabinet. It is a rubber-covered, two-conductor cable with male connector P2013 on one end and female connector P3204 on the other.

q. Electrical Special Purpose Cable Assembly CX–4012/U (1 ft 2 in.). Cable W723 connects the reticle lamp control to the reticle lamp mounted near the telescope on the scanner. This is a rubber-covered, two-conductor, shielded cable with male connector P3205 on one end and lamp socket XI 3201 on the other.

r. Electrical Power Cable Assembly CX–4009/U (2 ft 6 in.). Cable W724 connects the level illumination lamp to the pedestal. This is a rubber-covered, two-conductor cable with female connector P3021 on one end and male connector P3017 on the other.

s. Electrical Power Cable Assembly CX–4013/U (4 ft 2 in.). Cable W725 is connected between the scanner limit switches and the pedestal. This is a rubber-covered, two-conductor cable with female P3207 on one end and male connector P3018 on the other.

t. Electrical Power Cable Assembly CX–4011/U (6 ft 0 in.). Cable W726 connects the azimuth counter illumination to the pedestal. This is a rubber-covered, two-conductor cable with male connector P3016 on one end and female connector P3020 on the other.

u. Cable Assembly W727 (5 ft 8 in.). Cable W727 connects between the two blower assemblies in the operators' shelter. This is a rubber-covered, four-conductor cable with male connector P1008 on one end and female connector P1009 on the other.

v. Electrical Power Cable Assembly CX–4014/U (3 ft 0 in.). This is a rubber-covered, two-conductor cable with a male connector on one end and lug terminals on the other. Two of these cables are required.

(1) Interlock cable W728, with connector P3019, connects between jack J3019 and the curb-side fender interlock.

(2) Interlock cable W729, with connector P3009, connects between jack J3009 and the roadside fender interlock.

w. Electrical Power Cable Assembly CX–3903/U (1 ft 10 in.). Cable W730 connects the shelter intake blower to the control-indicator cabinet. It is a rubber-covered, two-conductor cable with male connector P1006 on one end and lug terminals on the other.

x. Ground Cable. The ground cable is a rubber-covered flexible cable. It connects between an external terminal on the radar trailer chassis and a clamp secured to the ground stake.

17. Electrical Power Requirements

a. Radar Set AN/MPQ–4A requires a 208/120-volt, 3-phase, 400-cps input. This is supplied by Gasoline Engine Generator Set PU–107A/U, or equivalent.

b. The radar set draws a maximum of 5.05 kilovolt-amperes (kva) at a power factor of 76.8 percent in radiate operation; 3.5 kva at a power factor of 77.8 percent in standby operation. The voltage applied to the set must remain between 115 and 135 volts at the power supply, and the frequency must be between 395 and 405 cps.

c. When the equipment is in *standby* operation, the current drain is as follows: phase 1, 9 amperes; phase 2, 11.2 amperes; and phase 3, 8.2 amperes.

d. When the equipment is in *radiate* operation, the current drain is as follows: phase 1, 10.2 amperes; phase 2, 11.3 amperes; and phase 3, 10.65 amperes.

Section III. BASIC PRINCIPLES

18. General

a. Radar Set AN/MPQ–4A radiates two beams, both scanning the same azimuth angle of 450 mils but separated in elevation by 36 mils (fig. 29). The antenna rotates through 6,400 mils for positioning purposes. The elevation angle limits are from —100 mils to +200 mils for the lower beam. A visual indicator, or B-scope, gives the range and azimuth of the target (projectile). This information is manually inserted into a computer which will give the range and azimuth of the weapon location, and also map coordinates to facilitate weapon location. A time correction factor may also be inserted into the computer for a more accurate range finding.

b. The reflected energy from the target is picked up by the antenna and a dot of light appears momentarily on the B-scope. Since the elevation angle of the lower beam is known, the center of the spot represents the three-dimensional space coordinates of the shell, expressed as elevation angle, azimuth angle, and slant range. As the shell intercepts the upper beam, another dot of light appears on the B-scope, representing a second set of three-dimensional coordinates. These coordinates of elevation angle, azimuth angle, and slant range locate the mortar in space in the upper beam. By using the stop clock on the indicator, the operator can measure the time the shell takes to travel from the lower beam to the upper beam. These two points in space represent two points on the shell's trajectory which are used in the computer to calculate the shell's origin.

c. Figure 3 presents the weapon location geometry used to obtain the east and north coordinates necessary to locate the weapon position. Part A, top view of the radar and weapon sites, shows the paths of the upper and lower beams. Part B is a side view of the same sector on the contour map. R_U is the slant range of the upper beam, R_L the slant range of the lower beam, and R_W the slant range of the weapon. In part C, E_U is the elevation angle of the upper beam, E_L the elevation angle of the lower beam; H_R is the height of the radar set, H_W the height of the weapon, and H the difference in height between the two. All heights are measured above sea level. Part D, another top view of the area, shows the azimuth angles. A_U is the azimuth angle of the upper beam, A_L the azimuth angle of the lower beam, and A_W the azimuth angle of the weapon.

19. Target Characteristics

For Radar Set AN/MPQ–4A, the target will be mortar shells or other low-velocity shells. Since the path of the shell is a curve; the best results are obtained by intercepting the path as near to the horizon as possible where the path is almost straight. Figure 4 shows the difference in results when the shell is intercepted at high and low elevation angles. If the shell is moving upward, the calculations will be the location of the mortar. If the shell is moving downward, the calculations will be the point of impact of the shell.

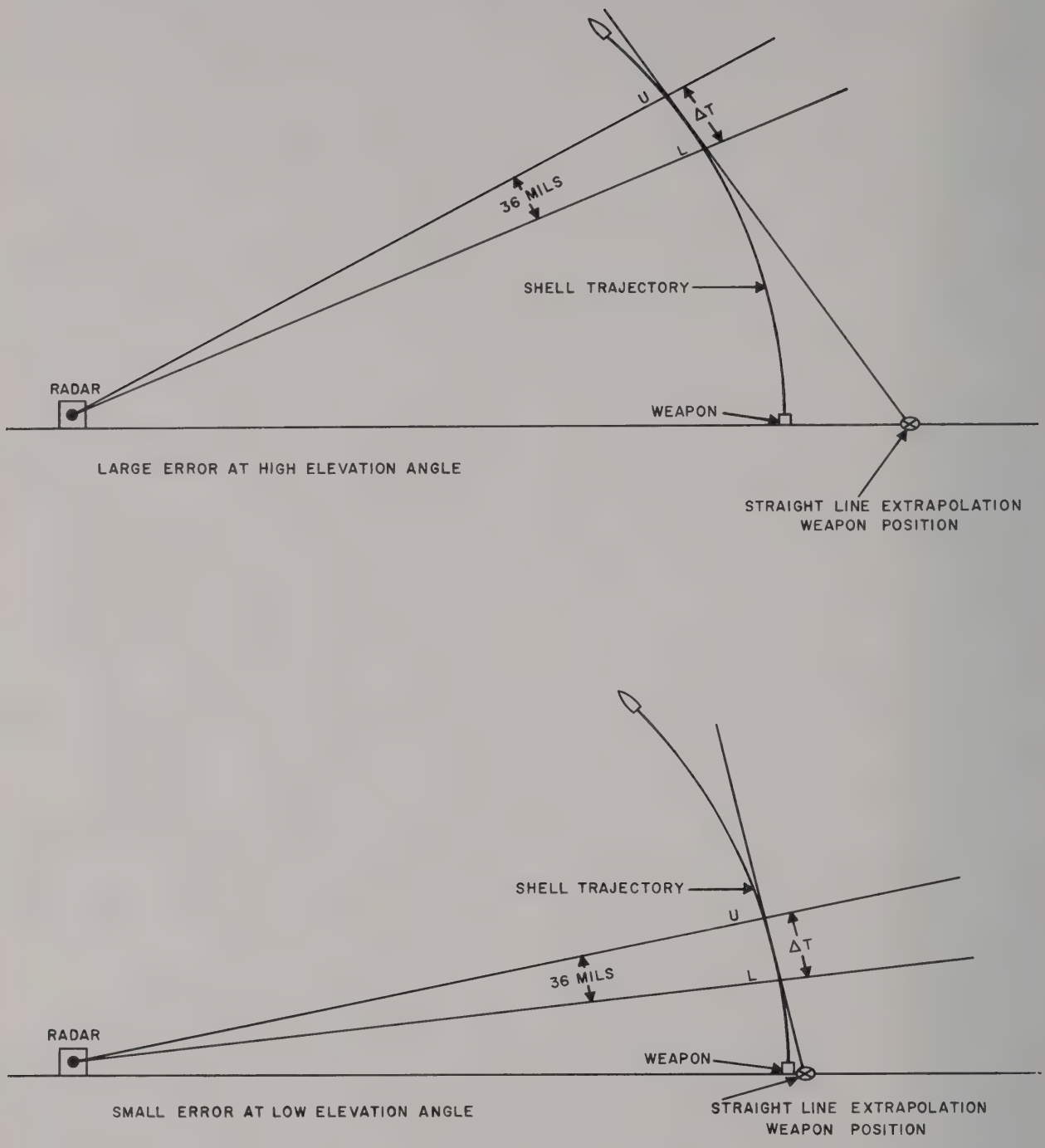
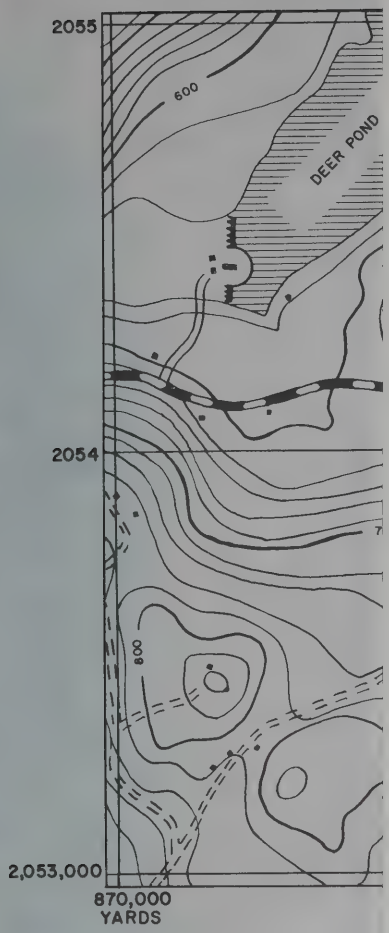


Figure 4. Straight line extrapolation of weapon position.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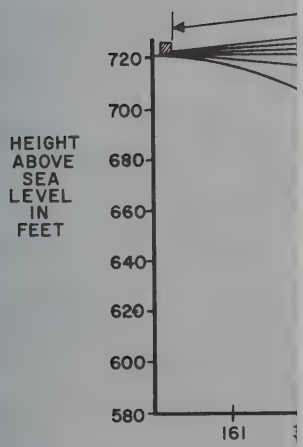
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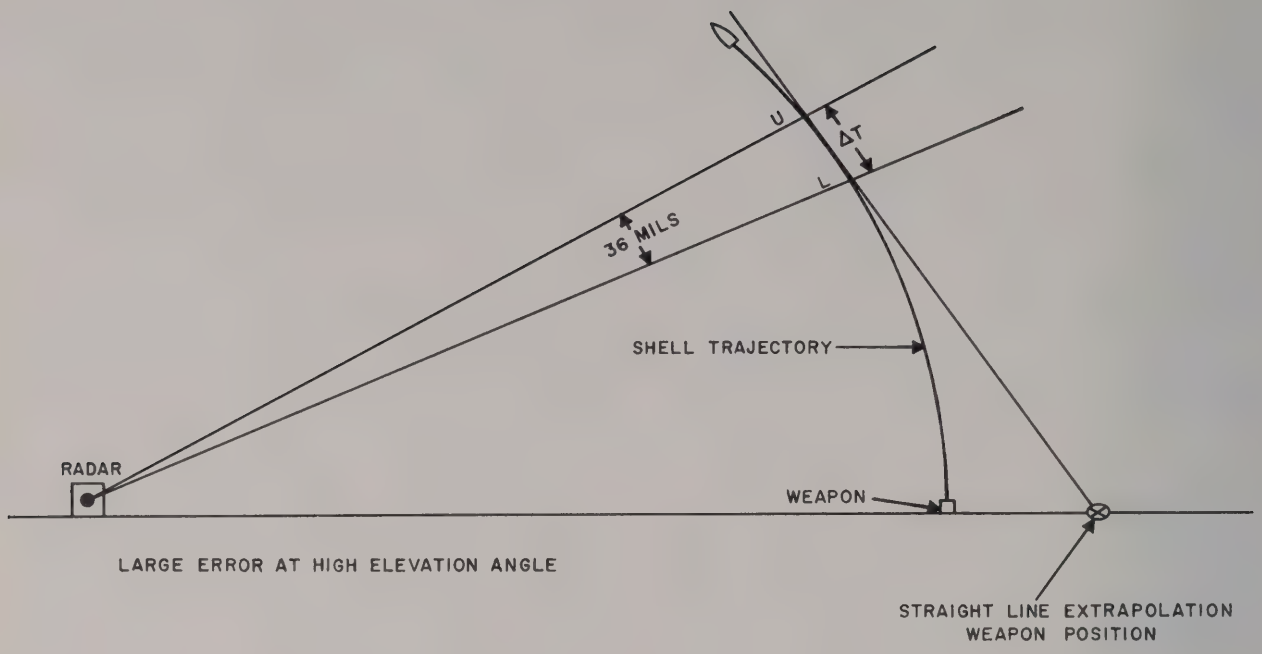

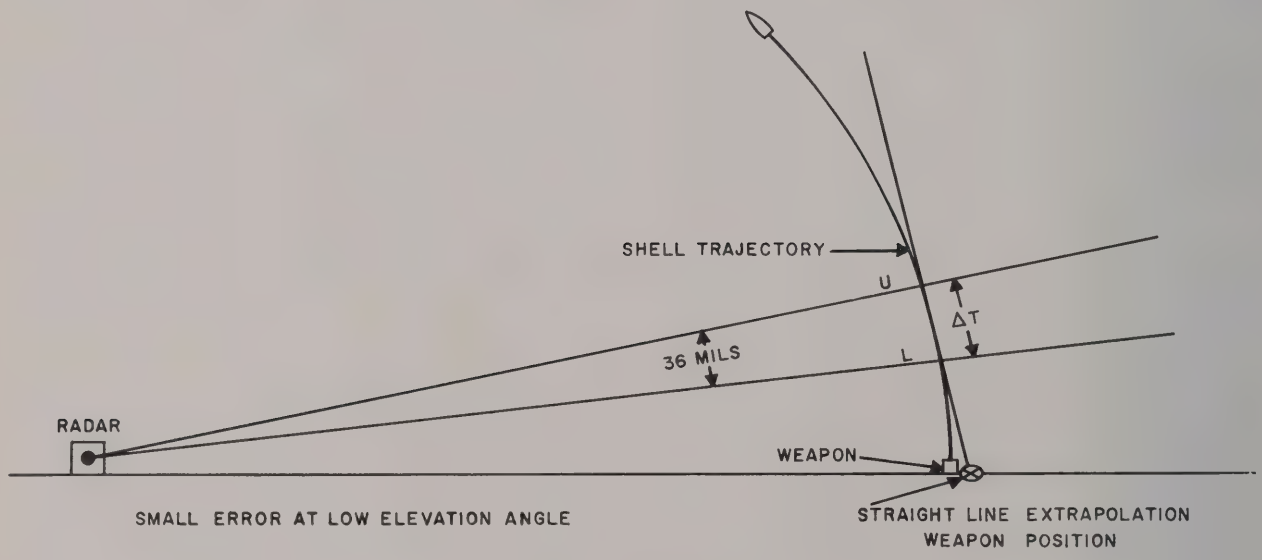

NOTES:

1. ΔT IS ELAPSED TIME BETWEEN L AND U.
2. WHEN T IS INSERTED IN COMPUTATIONS, THE CURVILINEAR EXTRAPOLATION APPROXIMATES VERY CLOSELY THE ACTUAL SHELL TRAJECTORY.

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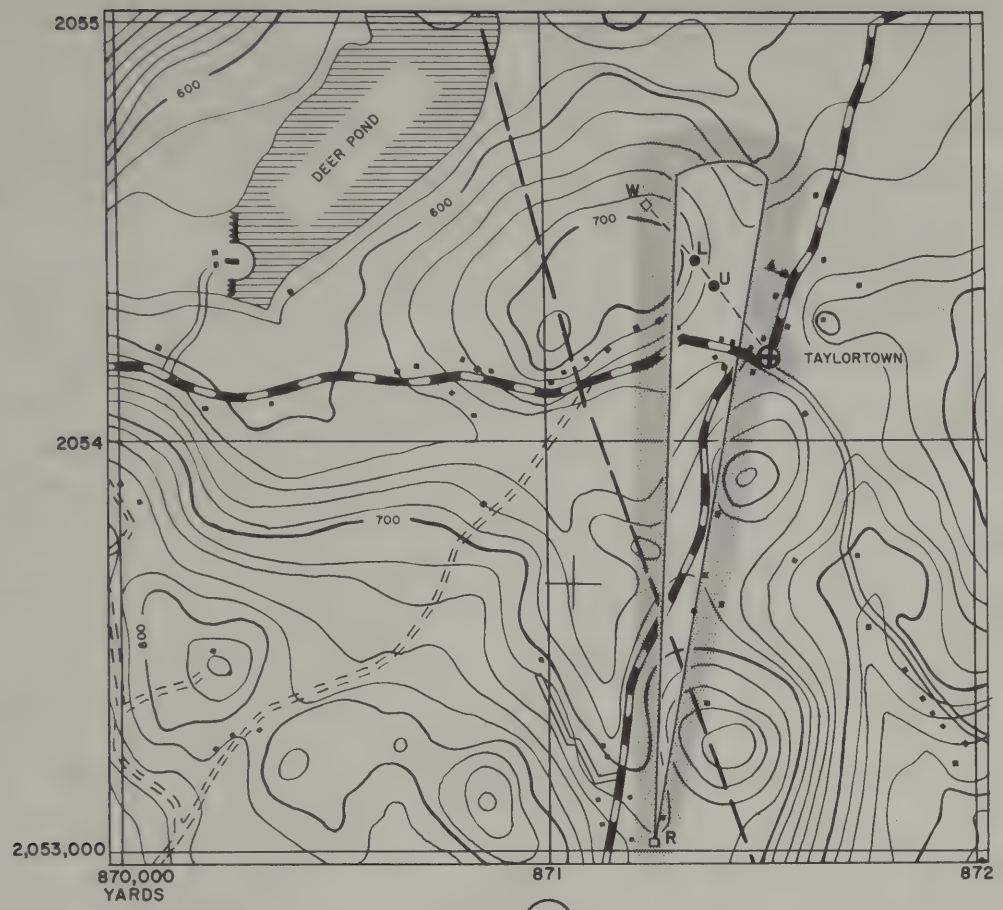
Figure 4. Straight line extrapolation of weapon position.



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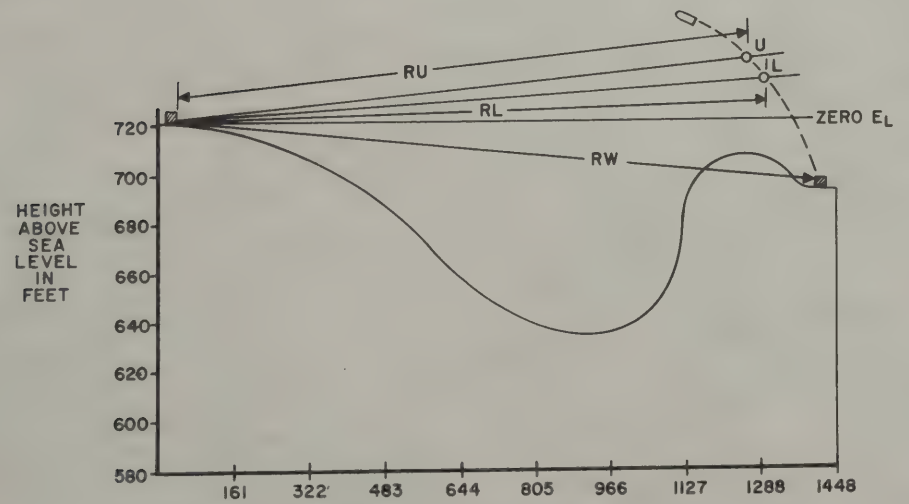

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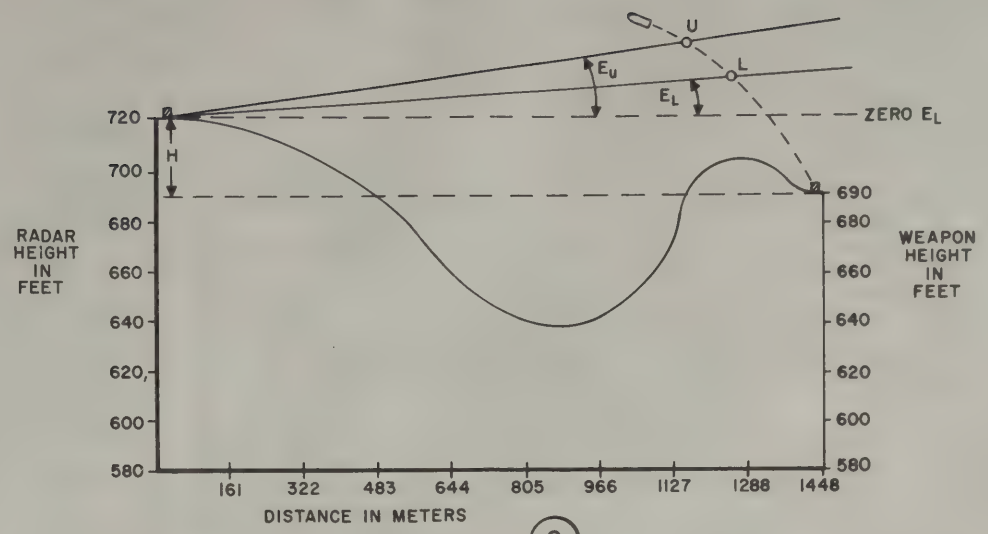
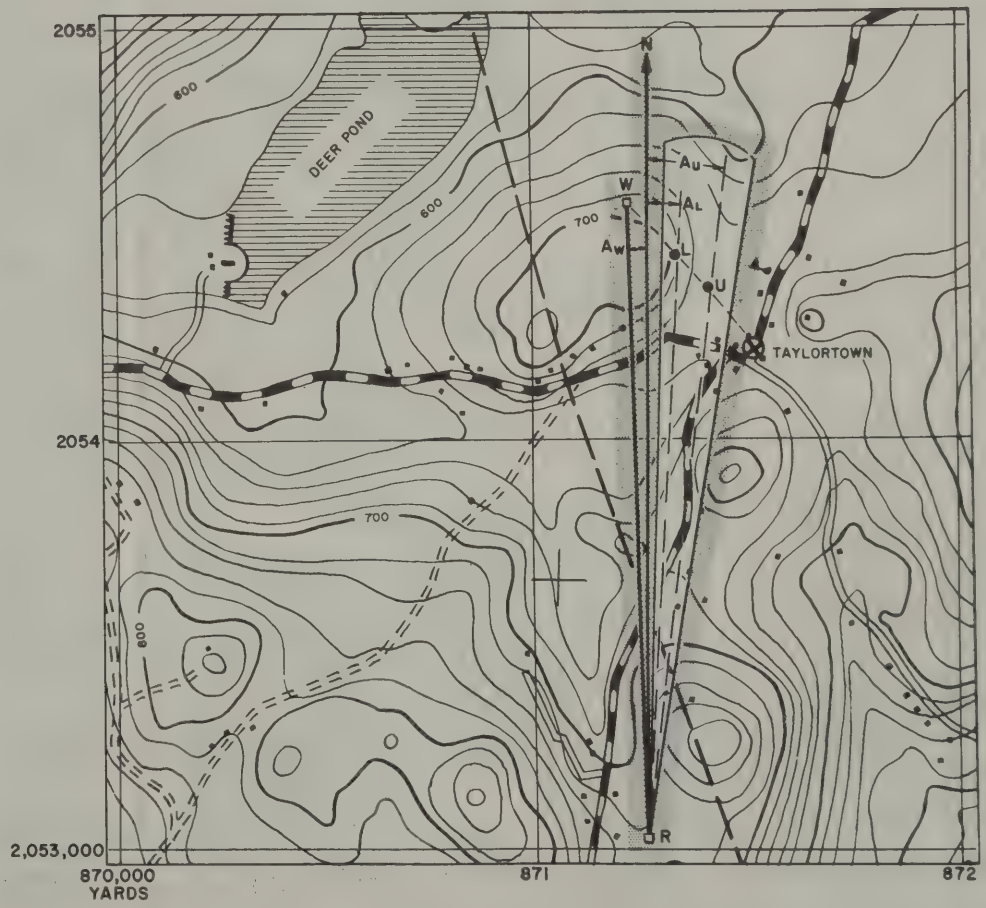


C



D

Figure 3. Weapon location geometry.

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20. Antenna Scanning

The scanning is accomplished by a Foster dual-beam scanner which alternately scans two beams 450 mils wide and 36 mils apart. The scanner can be moved to cover any 450-mil sector in a complete 6,400-mil circle, and has an internal rotation speed of approximately 1,000 rpm. The scanner also provides pulses for timing purposes.

21. Range Computation

a. The range of the target is the distance from the radar set to the target. A radar wave takes 6.6 microseconds (μsec) to make a round trip between the transmitter and a target which are 1,000 meters apart. If the time required is 66 μsec, the range is 10,000 meters.

b. By measuring the time elapsing between the transmitter signal and the return echo, the range of the target may be accurately determined. This range information is inserted into the computer.

22. Azimuth Computation

a. The azimuth of the target is the angle measured horizontally clockwise between the radar-to-target line and a reference line. When the mortar shell cuts the lower and upper beams, azimuth angles A_L and A_U (par. 18*c*) are obtained.

b. This azimuth information is presented to the computer through the azimuth servo system, and also by the visual presentation on the indicator B-scope.

23. Target Presentation

a. The target is intercepted by the lower antenna beam, which sends back an echo pulse to the receiver where it is amplified and presented on the B-scope as an intensified dot. The upper antenna beam then sends a similar echo pulse and a second dot appears on the scope. The upper beam indication is displaced by an increase in range of approximately 500 meters on the indicator. This prevents crowding of the signal presentation.

b. The position of the signal in a vertical direction indicates the range of the target, and the position of the signal in a horizontal direction indicates the azimuth of the target.

24. Determination of Weapon Position or Impact Area

a. The range and azimuth of the weapon or impact area is computed from equations, using the information presented on the B-scope. A more accurate solution of range results when the time interval of the shell, as it passes from the lower beam through the upper beam, is also inserted into the computer. This information is derived from the timer on the indicator control panel.

b. The position of the radar set (as determined by a survey of the area) is located on a grid coordinate map by using the north and east coordinates. Having located the radar on the map, the height of the radar is determined from the contour lines on the map. The radar east and north coordinates and the radar height are set into the computer.

c. Using the weapon location east and north coordinates as shown on the computer, the weapon is located on the map and the height of the weapon is read from the contour lines. The weapon height is inserted into the computer, giving the final solution to the weapon position problem.

CHAPTER 2
INSTALLATION

Section I. SERVICE UPON RECEIPT OF RADAR SET AN/MPQ–4A

25. Siting
(fig. 5)

Radar Set AN/MPQ–4A will operate to best advantage when it is installed in a suitable location. Consequently, careful consideration must be given to the selection of the site.

a. General Considerations. The ultra-high frequency waves transmitted and received by the radar set travel in a straight line. Since these waves cannot penetrate solid objects such as mountains, hills, or buildings, the path from the reflector to the target area must be free of solid obstructions.

b. Technical Considerations. One of the chief considerations in choosing a site is the effect it will have on the maximum range of the radar set. The higher the site, the greater the distance to the horizon; the higher the target, the farther beyond the horizon it may be detected. The maximum range of Radar Set AN/MPQ–4A is 10,000 meters. There should be a clear line-of-site path within this range.

c. Choice of Site. A reasonably level spot, free of obstructions, is required to locate the radar trailer and power unit. Suitable protection should be available for the control-indicator group when it is operated remotely up to 150 feet from the radar trailer. Another factor to remember is that the power unit may be located up to 100 feet from the control-indicator group.

26. Unpacking

a. Packaging Data. When packed for export shipment, Radar Set AN/MPQ–4A consists of the radar trailer, which mounts all of the radar set components; and the power unit, which carries accessories and spare parts.

b. Unpacking Radar Trailer.

(1) Remove the tarpaulin which covers the entire equipment; be careful to avoid damaging antenna components. Cables, connectors, and other projecting points may become damaged if the tarpaulin snags on any one of these points.

(2) Remove the 20 screws that secure the large end bell on the scanner and take out the two bags of disiccant from inside the scanner. Replace the large end bell.

(3) Remove the copper wire which holds the drain cock on the scanner in a closed position.

(4) Remove the water-resistant tape which covers the slip joint on the pedestal.

c. Unpacking Power Unit. (fig. 6). Untie the ropes that secure the front and rear tarpaulin flaps on the trailer. Throw the flaps up over the trailer roof and tie them together. In addition to the power unit, the trailer carries the following items:

(1) Shelter Intake Blower Assembly HD–279/MPQ–4A.

(2) Shelter Exhaust Blower Assembly HD–278/MPQ–4A.

(3) Control-Indicator Stand MT–1733/MPQ–4A.

(4) Operator's Seat Support MT–1798/MPQ–4A (2).

(5) Cable Reel RC–413/MPQ–4 (power cable).

(6) Cable Reel RC–419/MPQ–4 (remote cable).

(7) Spare Parts Chest CY–2201/MPQ–4A (contains one tube, QK324).

(8) Spare Parts Chest CY–2201/MPQ–4A (contains running spares, four technical manuals, and two circuit label books).

(9) Electrical Equipment Shelter S–134/MPQ–4A.

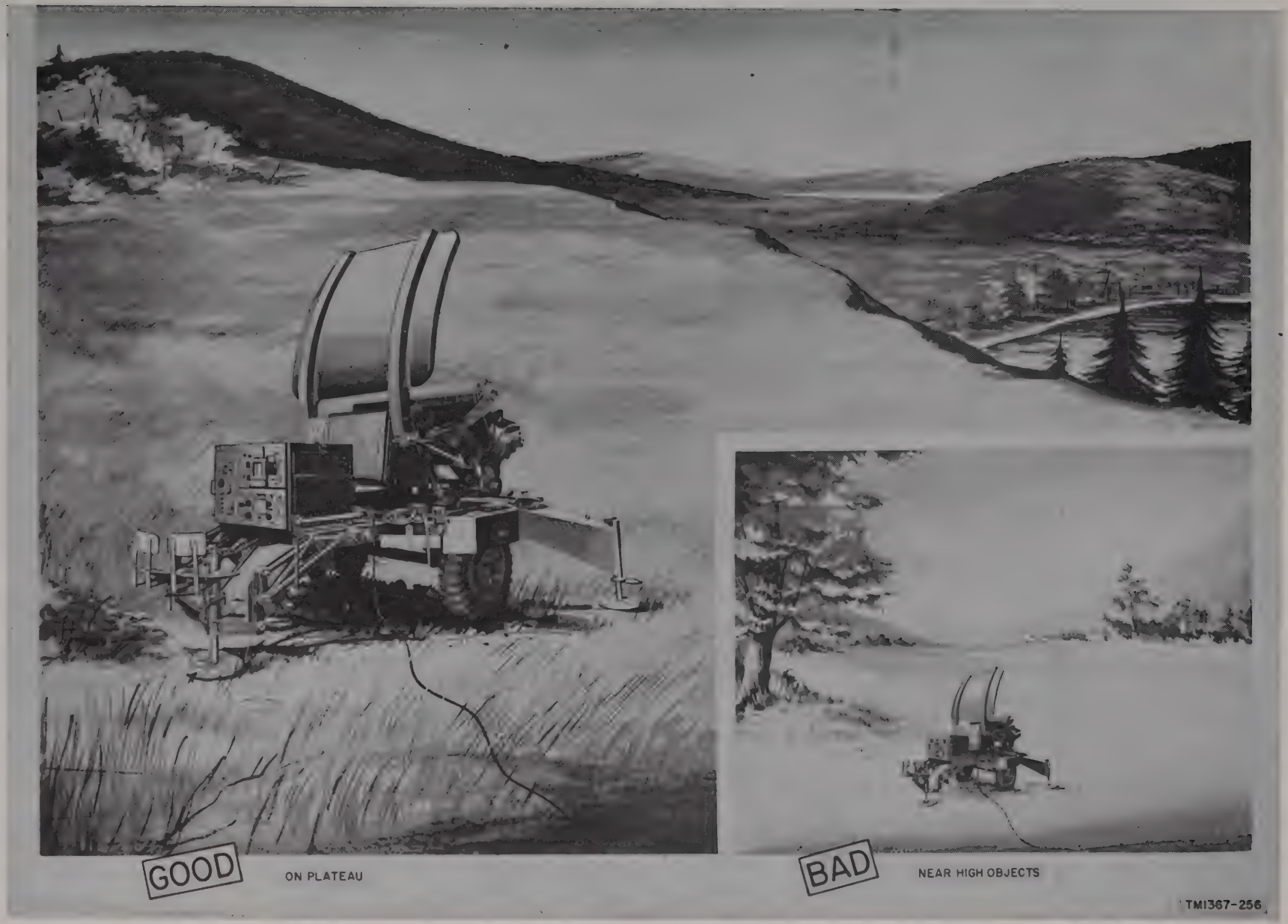


Figure 5. Siting Radar Set AN/MPQ–4A.

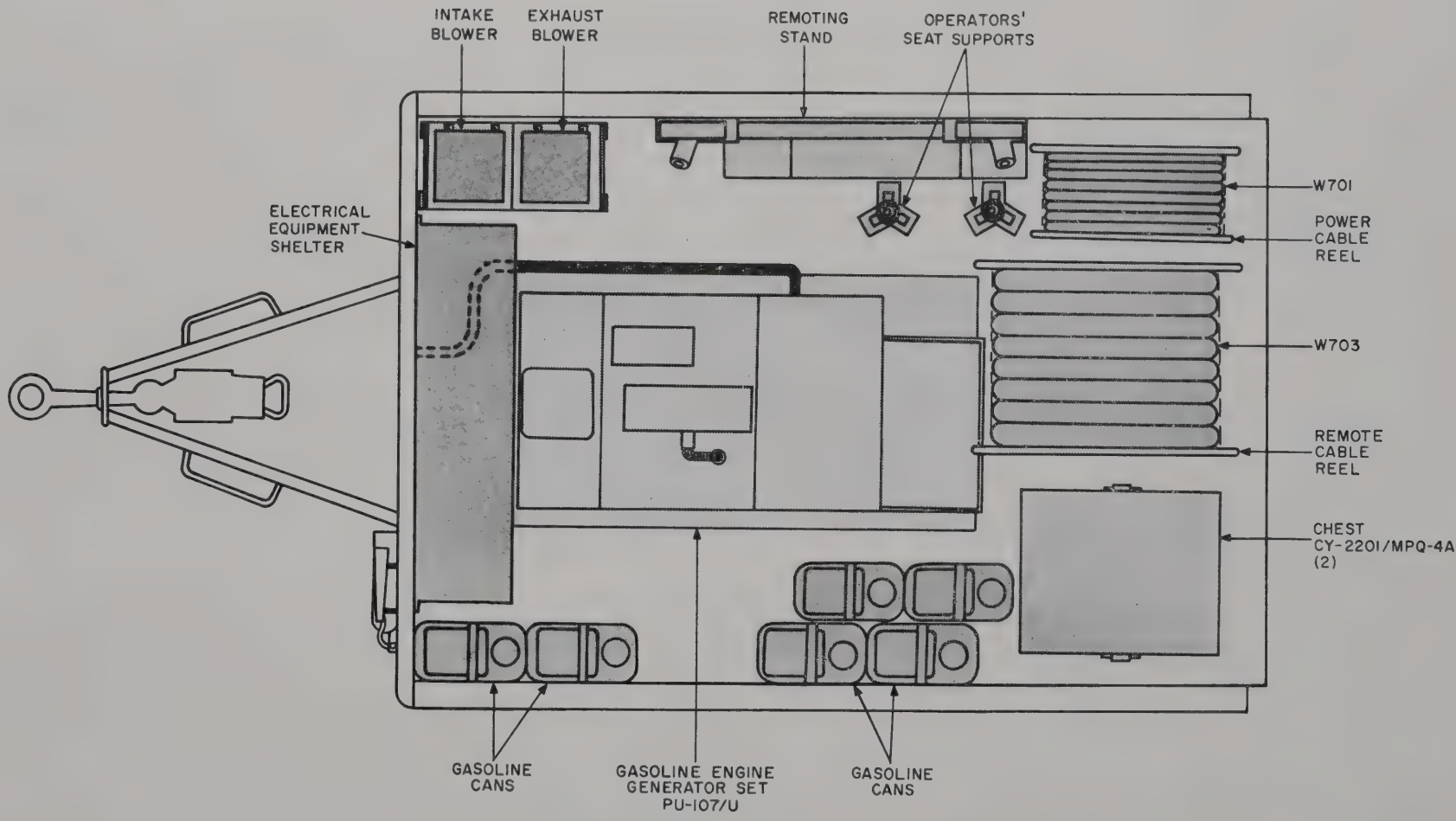


Figure 6. Trailer Mounted Gasoline Engine Generator Set PU–304A/MPQ–4, loading diagram.

27. Checking

a. After removing the tarpaulin from the radar set, examine the equipment for evidence of damage. Any deformation may offset reflector orientation with respect to the scanner which, in turn, will cause improper equipment operation. Damage to any part of the antenna group may also result in reduced structural strength. All antenna hardware should be checked and tightened where necessary.

b. Check to see that the equipment is complete as listed on the packing slip or in the list of components (par. 5).

c. If the equipment has been used or reconditioned, check to see whether it has been changed by a modification work order (MWO). If modified, the MWO number will appear near the name plate.

28. General Installation Instructions

Note. The installation procedures given in this paragraph through paragraph 34 are applicable for initial installation and for installation after long or short hauls. Refer also to paragraphs 25, 26*c*, and 27 for siting and checking the equipment.

a. Four men are required to install Radar Set AN/MPQ–4A. An experienced crew can set the equipment up for local operation in about 15 to 30 minutes.

b. Determine a site for the equipment as outlined in paragraph 25.

c. Install and set up the radar set in the order given below. A detailed outline of these steps is given in paragraphs 29 through 35.

(1) Installation of radar trailer (par. 29).
(2) Installation of power unit (par. 30).
(3) Erection of reflector (par. 31).
(4) Local operation (par. 32).
(5) Remote operation (par. 33).
(6) Cabling and connections (par. 34).
(7) Cabling check (par. 35).

Note. Certain cables must be connected during the installation procedure.

d. All hardware required to assemble or install the radar set is chained or clipped to the components near the holes where the hardware is used.

e. Most of the interconnecting cables have male connectors at one end and female connectors on the other. The others are terminated with lug terminals or lamp sockets, depending on the type connection to be made. Cables, connectors, and receptacles of the various components are equipped with captive protective caps wherever necessary to prevent corrosion of the threaded parts.

29. Installation of Radar Trailer

a. When the radar trailer is pulled into an operating site it should, if possible, be situated on level ground. The outrigger arms can only accommodate a maximum slope of 90 mils. If the radar trailer is pulled into a slope, the surrounding ground should be used to best advantage in the leveling of the radar set.

b. Before detaching the radar trailer from the prime mover, lower the front-end landing wheel to carry the lunette eye load of the trailer and set the handbrakes. Disconnect the air hose coupling and the trailer power cable from the prime mover, and attach them to the clamps on the trailer. With two men performing the operation, lift the lunette eye off the spindle hook on the prime mover and lower it carefully to the ground. Move the prime mover away.

c. Remove the three outrigger pads from their stowage location on the curb-side fender support. Place the outrigger pads on the ground at the left side, right side, and rear of the trailer.

d. Release the right and left outrigger arms by disconnecting the locking pins on the support rod (fig. 7), and lower the outrigger arms. Secure the outrigger arms to the trailer with the locking screws (fig. 8).

e. Position the right and left outrigger pads directly underneath the jackscrews. Operate the ratchet hand crank to lower the jackscrews until they contact the outrigger pads.

Caution: Be extremely careful in performing the next operation. Three men are required to lower the rear outrigger arm; one at each end, and one at the center post.

f. Release the rear outrigger arm by unscrewing the transit locking screws and loosening the pivot screw on each side of the radar trailer (fig. 9). Lower the outrigger arm.

g. Reassemble the outrigger arm with the operational locking screws found on each side (fig. 10).

h. Place the outrigger pad directly underneath the jack screw. Use the hand crank and lower the jack screw until it contacts the outrigger pad.

i. See that the locking screws (*d* and *g* above) are securely tightened.

j. Disengage the azimuth stowlock (fig. 1).

k. Rotate both wheel fenders outward by disengaging the locking pins (fig. 1).

l. Rotate the antenna carefully by using the azimuth hand wheel (fig. 11). Observe that there is no interference between components as the antenna rotates.

Note. The azimuth hand wheel should be pushed all the way in for this operation. When the hand wheel is halfway out, the antenna may be rotated by hand. For automatic azimuth operation, the hand wheel must be pulled out all the way. Disengage the locking pin to place the hand wheel shaft in the desired position.

m. Remove the waterproof cover from the spirit level assembly (fig. 1). Level the radar set by properly adjusting the elevation of the jack screws until the level bubble is within the inner scribed circle. Rotate the antenna to other azimuth positions and check for levelness of the level bubble. The leveling operation must be accomplished with a minimum extension of the outrigger jack screws to insure that the available adjustment is not exhausted and also to minimize antenna silhouette height. The majority of the weight should be removed from the trailer wheels to insure maximum stability.

n. Remove the protective caps on the intake and exhaust vents on the scanner (fig. 1).

Note. In initial installation, the intake vent on the small end bell will be covered with a humidity indicator cap. The indicator cap will be blue if scanner humidity is normal. Remove the cap and put it in a safe place until required for limited storage.

o. Remove the ground stake (fig. 12) from the radar trailer by opening the clamp and removing the ground stake from the sleeve attached to the frame. Uncoil the ground cable. Drive the ground stake at least half its length into the ground.

p. If equipment is being installed for the first time, perform the following additional steps:

(1) Pull open the control-power supply drawer and remove the two bags of desiccant from below the drawer. In addition, remove the humidity indicator card from the drawer. Untape the eyebolts from the cabinet handles and replace in the four holes on top of the cabinet.

(2) Pull open the low-voltage power supply drawer and remove the two bags of desiccant from below the drawer. Remove the humidity indicator card from the bottom of the transmitter compartment and see that the spots on the card are blue.

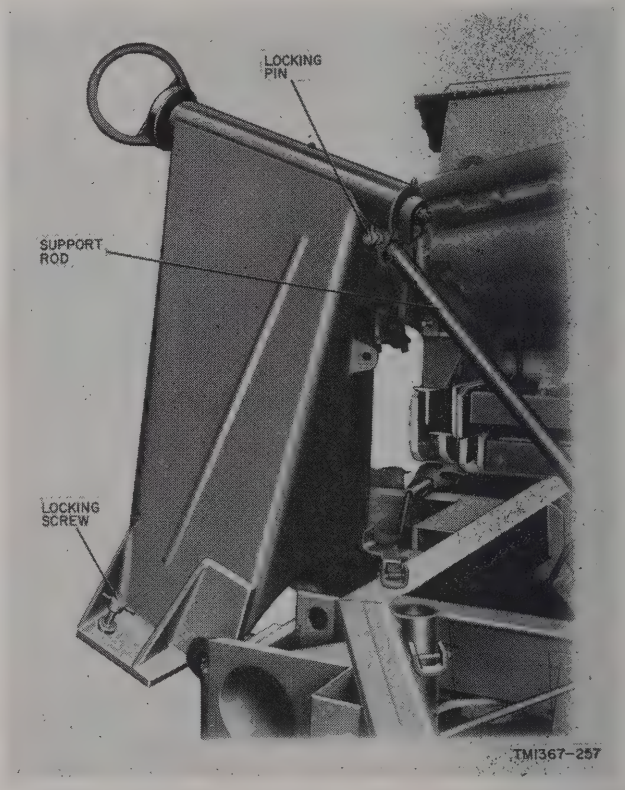


Figure 7. Side outrigger arm in transit position.

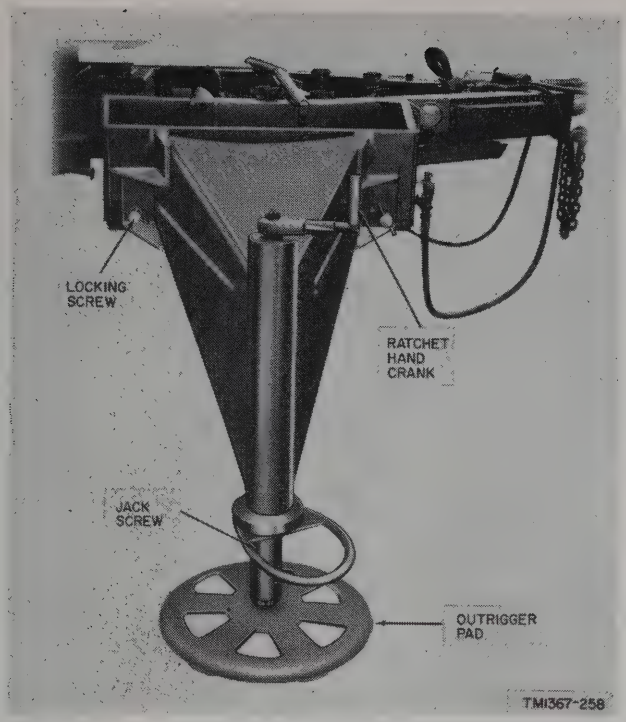


Figure 8. Side outrigger arm in operational position.

30. Installation of Power Unit

a. Select a level, protected site within 100 feet of the control-indicator group. Before detaching the power unit from the prime mover, set the hand brakes and lower the front-end landing wheel to carry the lunette eye load. At the rear of the power unit, drop down the support leg and lock it into position. Disconnect the air hose coupling and the power cable from the prime mover, and attach them to clamps on the trailer. Detach the power unit from the prime mover and move the prime mover away.

b. Remove the tarpaulin from the power unit. Make a visual check of the PU–107A/U before starting it to be sure the equipment is intact and has not been damaged in shipping and handling. For further checks see TM 5–5264.

31. Erection of Reflector

The reflector is stowed in a hinged forward position during transit, resting on stowing pads mounted on the end bells of the scanner. The azimuth stowlock on the radar trailer holds the pedestal and scanner in position, so that the scanner is toward the front of the trailer. To erect the reflector for operation (fig. 1), proceed as follows:

a. Release the reflector clamps (fig. 13) and pivot the clamps clear of the reflector.

b. Raise the reflector by turning the handcranks (fig. 14), attached to the linear actuators, one on each side of the antenna support structure. Turn the cranks until the reflector support beams seat securely against the pads provided on the antenna support structure.

c. Secure the reflector in its operating position by pulling out the locking pins and swinging the locking screws (fig. 14) up into the slot on the bottom of the reflector support beams. Tighten the screws to lock the reflector securely in position.

32. Local Operation

In local operation, the control-indicator group is operated at the radar trailer.

a. Installation of Operators' Seats (fig. 10).

(1) Swing the support arms on the rear jack assembly out into operating position.

(2) Remove the two seats from their stowed position on the forward portion of the radar trailer.

(3) Place the seats in the sockets provided on the support arms and aline with locating pins.

b. Installation of Operators' Shelter. Figure 15 shows the assembly of the operators' shelter. The numbers on the drawing are refered to in the following procedure:

(1) Release the straps which secure the operators' shelter in the power unit (fig. 6).

(2) Transport the case to the operating site.

(3) Place the transit case on its side (1, fig. 15), release the latch locks, and open the case (2, fig. 15).

(4) Remove the canvas, equipment picture frame, leg braces, ground pads, ground stakes, and web straps from the case. Place on the ground near the case.

(5) Remove the two eyebolts from the top front of the control-indicator cabinet.

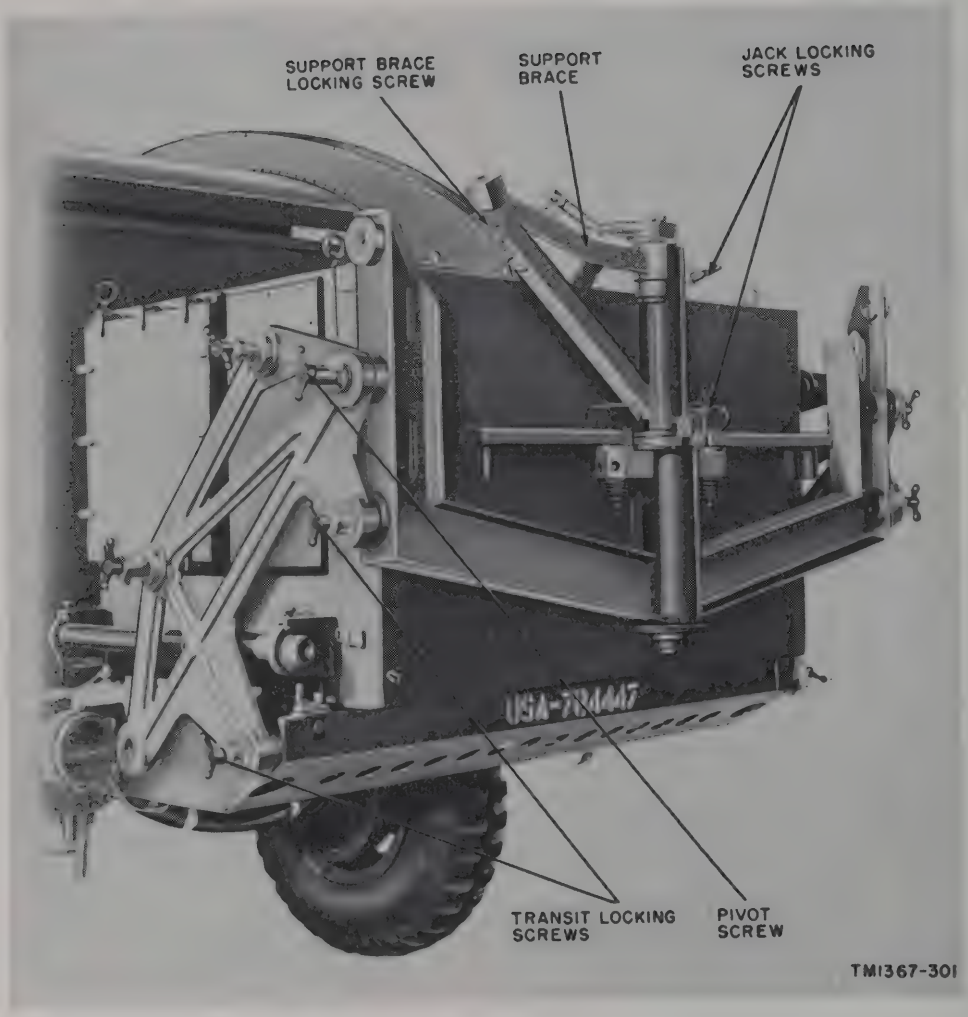


Figure 9. Rear outrigger arm in transit position.

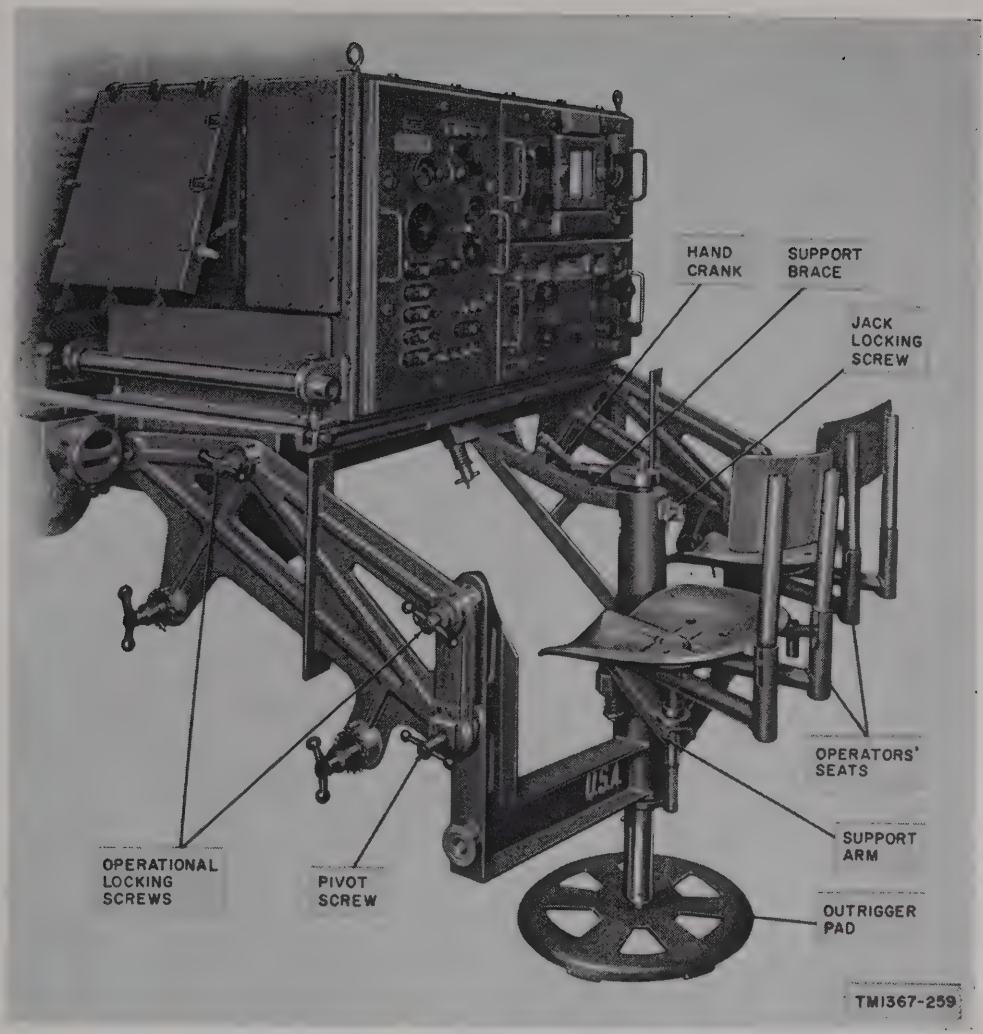


Figure 10. Antenna trailer in operational position, partial rear view.

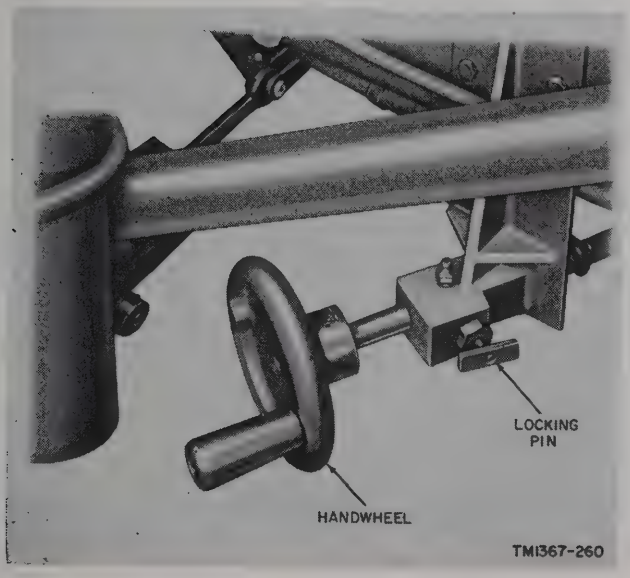


Figure 11. Azimuth handwheel.

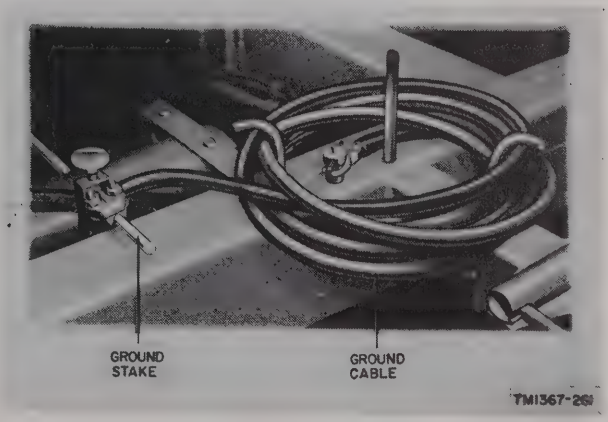


Figure 12. Ground stake and cable.

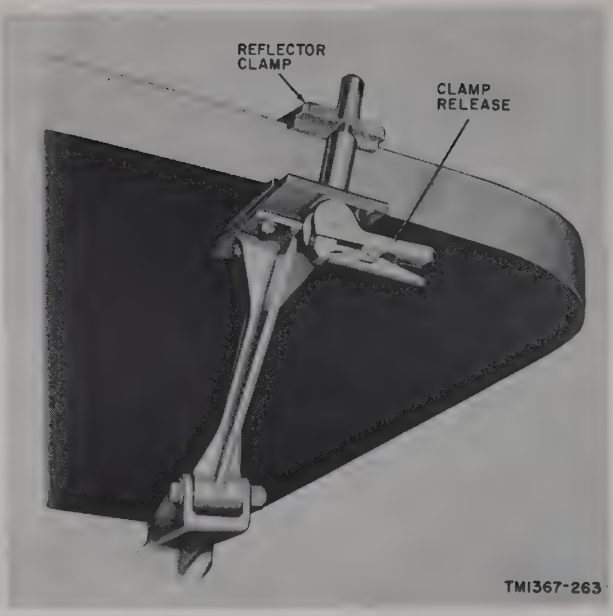


Figure 13. Reflector in stowed position, partial view.

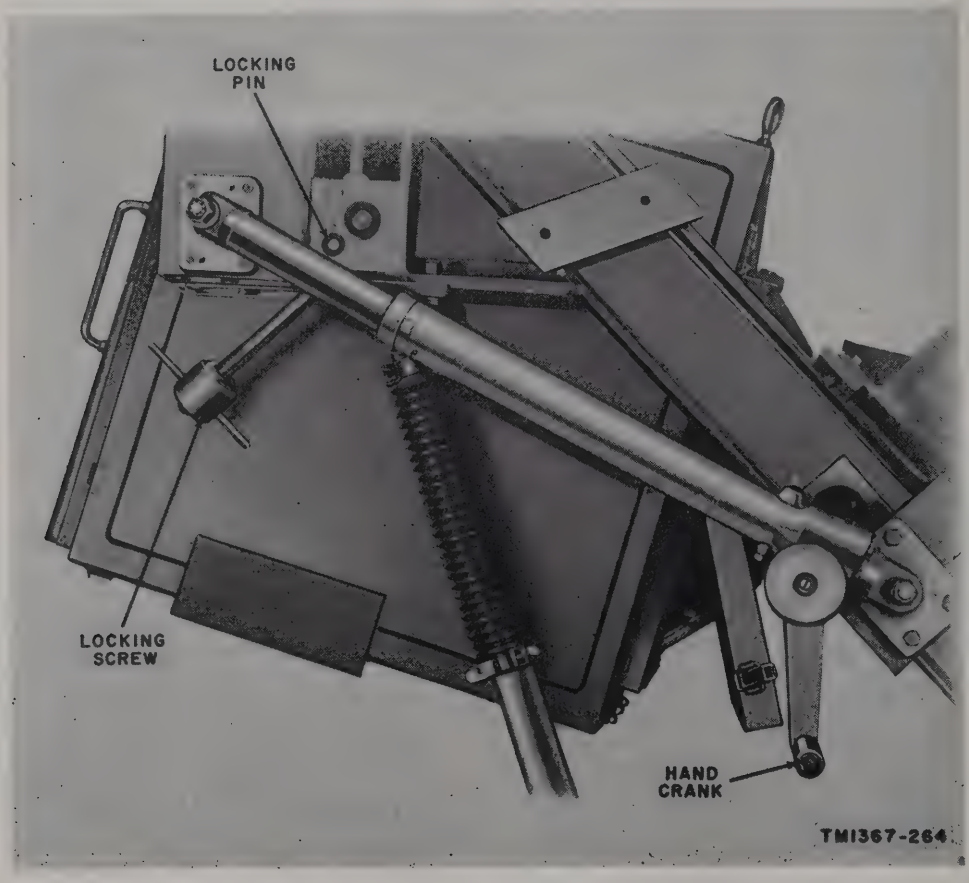


Figure 14. Reflector locking screw and handcrank.

(6) Remove the control-indicator transit cover and stow on top of cabinet.

(7) Place the equipment picture frame (3, fig. 15) and attached canvas in position on the front of the control-indicator cabinet. Lock the picture frame in place with the nine latches. Secure at the top with the two $\frac{3}{8}$–16 eyebolts ((5) above).

(8) Snap the bottom portions of the equipment-side wall to the mounting flanges on the rear jack support braces (4, fig. 15). Secure the bottom edges with the zippers.

(9) Loosen the two locking screws on the jack asembly and swing the support brace into position (fig. 10). Fasten the support brace to the radar trailer with the locking screw. Tighten the two locking screws on the jack.

(10) Position the case with the blower mounting frames away from the control-indicator cabinet (4, fig. 15). Swing the frames into a vertical position and lock into position with the leg braces.

(11) Erect the entrance-side legs and lock into position with the leg braces. Position the ground pads on the legs and lock in place.

(12) Place the case on edge, overturn, and position on cabinet, mating the slots on the blower mounting frames with the lock studs on the picture frame (5, fig. 15). Tighten the two lock studs.

(13) Adjust the leg heights to level and support the transit case which now forms the shelter roof.

(14) Place the main tarpaulin over the top and sides of the transit case and secure it to the equipment-side wall with the zippers.

(15) Moor the operators' shelter with the eight ground stakes and eight web straps. Tie the protective flaps in place over the top portion of each web strap (6, fig. 15).

(16) Remove the two blower cases from their stowed position on the power unit.

(17) Position the intake blower in the mounting frame located in the right front corner of the operators' shelter. Secure with the three clamps.

(18) Position the exhaust blower in left front blower mounting frame and secure with the three clamps.

(19) Open the blower case covers inside the operators' shelter and lock in position with the doors locks (6, fig. 15). See that all switches are in the *off* position.

(20) Open the blower case covers outside the operators' shelter and lock in position with the door locks.

(21) Check the installation for light leakage and adjust as required.

c. Cables. Install the cables for local operation as outlined in paragraph 34.

33. Remote Operation

In remote operation, the control-indicator group is operated at a site up to 150 feet from the antenna trailer. Avoid the area immediately in front of the antenna, or within the radiation path of the antenna as it sweeps the target area. Disconnect all cables from the control-indicator group before placing it in a remote position.

a. Installation of Remoting Stand. Remove the remoting stand for the control-indicator from the power unit trailer and assemble as follows:

(1) Place the stand upside down on the ground.

(2) Pull out the thumb pin that holds the leg-stowing clamp in position, and remove the four legs.

(3) Insert one of the legs in the socket mounted at the corner of the stand.

(4) Pull the retainer pin out far enough to allow the leg sufficient passage.

(5) Rotate the leg until it locks into place. When properly seated, the leg pads will set squarely on the ground.

(6) Repeat the procedures in (1) through (5) above, for the other three legs.

(7) Replace the leg-stowing clamp by pulling out the retainer pin and snapping the clamp into position.

(8) Place the remoting stand in its remote location.

(9) Remove the two pip pins from the top of the stand and lay them aside.

b. Installation of Control-Indicator Group.

(1) Unbolt the control-indicator group from the antenna trailer.

(2) Disconnect cable W702 from jack J1002, and disconnect cable W701 from jack J1001, if connected.

(3) Extend the tubular carrying handles and, with four to six men assisting in the operation, carry the cabinet to the remote site. (This component weighs approximately 750 pounds.)

(4) Slide the cabinet into position on the stand and mate the slots on the cabinet with the positioning holes in the stand. Insert the two pip pins through the holes to secure the cabinet to the stand.

c. Installation of Operators' Seats.

(1) Remove the two seats from the antenna trailer.

(2) Remove the two operators' seat supports from the power unit trailer (fig. 6).

(3) Release the strap on each seat support to unlock the legs.

(4) Extend the legs into position.

(5) Place each seat in the sockets provided on the supports and position with the two pins on each base.

(6) Adjust the height of each seat as desired.

d. Installation of Operators' Shelter. To install the shelter, follow the procedure given in paragraph 32*b*.

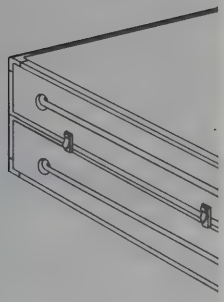
e. Cables. Install the cables for remote operation as outlined in paragraph 34.

34. Cabling and Connections (fig. 16)

The components of Radar Set AN/MPQ–4A are interconnected by cables. Most of these cables are in place when the equipment is received, with the exception of the following:

a. For local operation, remove cable assembly CX–2771/U (cable W701) from Cable Reel RC–413/MPQ–4 on the power unit trailer (fig. 6). Insert plug P1001 into jack J1001 on the control-indicator group and plug P701, the other end, into receptacle J701 on the power unit.

b. For remote operation, install cable W701 as indicated in *a* above. Remove cable assembly CX–4103/MPQ–4 (cable W703) from Cable Reel RC–419/MPQ–4 on the power unit (fig. 6). Connect it between cable W702 and jack J1002 on the control-indicator group.



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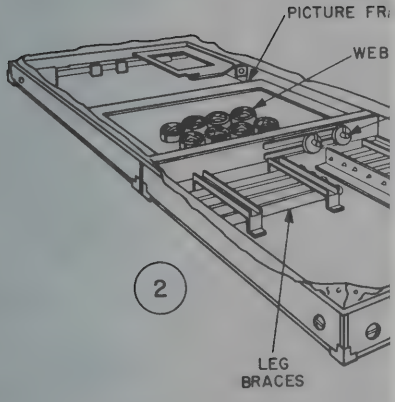

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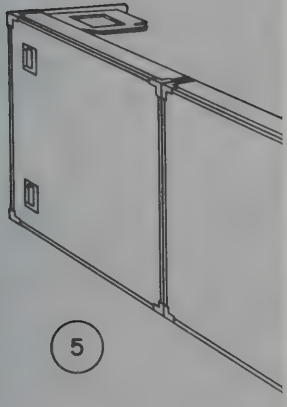

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33. Remote Operation

In remote operation, the control-indicator group is operated at a site up to 150 feet from the antenna trailer. Avoid the area immediately in front of the antenna, or within the radiation path of the antenna as it sweeps the target area. Disconnect all cables from the control-indicator group before placing it in a remote position.

a. Installation of Remoting Stand. Remove the remoting stand for the control-indicator from the power unit trailer and assemble as follows:

(1) Place the stand upside down on the ground.

(2) Pull out the thumb pin that holds the leg-stowing clamp in position, and remove the four legs.

(3) Insert one of the legs in the socket mounted at the corner of the stand.

(4) Pull the retainer pin out far enough to allow the leg sufficient passage.

(5) Rotate the leg until it locks into place. When properly seated, the leg pads will set squarely on the ground.

(6) Repeat the procedures in (1) through (5) above, for the other three legs.

(7) Replace the leg-stowing clamp by pulling out the retainer pin and snapping the clamp into position.

(8) Place the remoting stand in its remote location.

(9) Remove the two pip pins from the top of the stand and lay them aside.

b. Installation of Control-Indicator Group.

(1) Unbolt the control-indicator group from the antenna trailer.

(2) Disconnect cable W702 from jack J1002, and disconnect cable W701 from jack J1001, if connected.

(3) Extend the tubular carrying handles and, with four to six men assisting in the operation, carry the cabinet to the remote site. (This component weighs approximately 750 pounds.)

(4) Slide the cabinet into position on the stand and mate the slots on the cabinet with the positioning holes in the stand. Insert the two pip pins through the holes to secure the cabinet to the stand.

c. Installation of Operators' Seats.

(1) Remove the two seats from the antenna trailer.

(2) Remove the two operators' seat supports from the power unit trailer (fig. 6).

(3) Release the strap on each seat support to unlock the legs.

(4) Extend the legs into position.

(5) Place each seat in the sockets provided on the supports and position with the two pins on each base.

(6) Adjust the height of each seat as desired.

d. Installation of Operators' Shelter. To install the shelter, follow the procedure given in paragraph 32*b*.

e. Cables. Install the cables for remote operation as outlined in paragraph 34.

34. Cabling and Connections
(fig. 16)

The components of Radar Set AN/MPQ–4A are interconnected by cables. Most of these cables are in place when the equipment is received, with the exception of the following:

a. For local operation, remove cable assembly CX–2771/U (cable W701) from Cable Reel RC–413/MPQ–4 on the power unit trailer (fig. 6). Insert plug P1001 into jack J1001 on the control-indicator group and plug P701, the other end, into receptacle J701 on the power unit.

b. For remote operation, install cable W701 as indicated in *a* above. Remove cable assembly CX–4103/MPQ–4 (cable W703) from Cable Reel RC–419/MPQ–4 on the power unit (fig. 6). Connect it between cable W702 and jack J1002 on the control-indicator group.

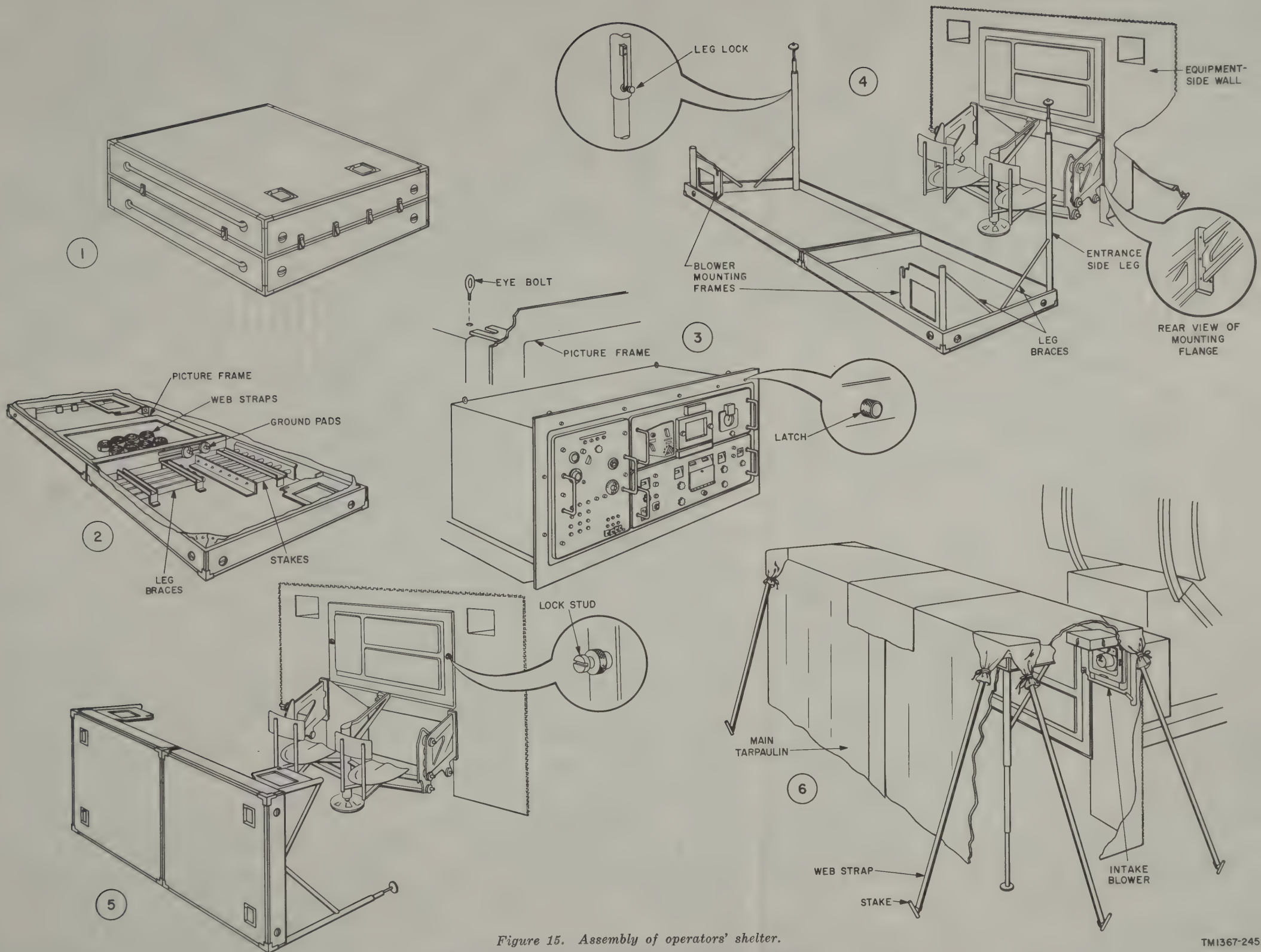

Figure 15. Assembly of operators' shelter.

c. For both local and remote operations, make these interconnections:

(1) Connect cable assembly CX–3900/U (cable W771). One end of this cable is permanently attached to the overhead lamp assembly in the intake blower assembly (operators' shelter). Insert the connector on the other end (P1004) into jack J1004 on the control-indicator group.

(2) Connect cable W727 between the two blower assemblies in the operators' shelter. The cable is secured to one of the blowers by a captivated chain when not connected.

(3) Connect cable assembly CX–3903/U (cable W730). One end of this cable is permanently fastened to the intake blower assembly. Insert the connector on the other end (P1006) into jack J1006 on the control-indicator group.

35. Cabling Check

Check the connections between components of Radar Set AN/MPQ–4A with the information given in the charts below and in figures 16, 17, and 18.

a. Cables To Be Connected.

Cable No.	Nomenclature	Length		Connects	
		ft	in.	From	To
W701	CX–2771/U	101	0	Control-indicator group (J1001)	Power unit (J701).
W703	CX–4103/MPQ–4	150	0	Control-indicator group (J1002) remote operation only.	Cable W702 (P1002).
W711	CX–3900/U	4	0	Control-indicator (J1004)	Overhead lamp assembly (operators' shelter).
W730	CX–3903/U	4	10	Control-indicator (J1006)	Intake blower assembly (operators' shelter).
W727		6	8	Intake blower assembly (J1008)	Exhaust blower assembly (J1009).

b. Cables To Be Checked.

Cable No.	Nomenclature	Length		Connects	
		ft	in.	From	To
				External cables	
W702	CX–3898/U	6	8	Control-indicator (J1002) for local operation; cable W703 (P704) for remote operation.	Pedestal (J3010).
W704	CX–3904/U	3	0	Receiver-transmitter (J2001)	Pedestal (J3001).
W705	CG–783A/U	3	0	Receiver-transmitter (J2004)	Pedestal (J3004).
W706	CG–783A/U	3	0	Receiver-transmitter (J2005)	Pedestal (J3005).
W707	CG–783A/U	3	0	Receiver-transmitter (J2006)	Pedestal (J3006).
W708	CX–3904/U	3	0	Receiver-transmitter (J2002)	Pedestal (J3002).
W709	CX–3902/U	3	0	Receiver-transmitter (J2003)	Pedestal (J3003).
W710	CX–3905/U	6	6	Receiver-transmitter (J2012)	Dehydrator (J3301).
W712[a]				Receiver-transmitter	W713.
W713[a]				W712	Directional coupler.
W714[a]				Directional coupler	W715.
W715[a]				W714	W745.
W745[a]				W715	Scanner.
W743[a]				Directional coupler	W744.
W744[a]				W743	Echo box.

Cable No.	Nomenclature	Length		Connects	
		ft	in.	From	To
				External Cables—continued	
W717	CX–3902/U	4	0	Receiver-transmitter (J2009)	Scanner (J3202).
W718	CX–4104/U	4	0	Receiver-transmitter (J2010)	Elevation motor (J3012).
W722	CX–3901/U	6	8	Receiver-transmitter (J2013)	Reticle lamp control (J3204).
W723[b]	CX–4012/U	1	2	Reticle lamp control (J3205)	Reticle lamp (X13201).
W741	CG–783A/U	3	0	Receiver-transmitter (J2008)	Pedestal (J3007).
W716	CX–4062/U	4	6	Pedestal (J3008)	Scanner (J3203).
W719	CX–4016/U	3	9	Pedestal (J3013)	Elevation synchro (J3014) on antenna support structure.
W720	CX–4015/U	5	2	Pedestal (J3011)	Scanner motor (J3201).
W721	CX–4010/U	2	0	Pedestal (J3015)	Azimuth stow switch.
W724	CX–4009/U	2	6	Pedestal (J3017)	Level illumination (J3021).
W725	CX–4013/U	4	2	Pedestal (J3018)	Scanner limit switches (J3207).
W726	CX–4011/U	6	0	Pedestal (J3016)	Azimuth counter illumination (J3020).
W728	CX–4014/U	3	0	Pedestal (J3019)	Curb-side fender interlock.
W729	CX–4014/U	3	0	Pedestal (J3009)	Roadside fender interlock.
Ground cable				Antenna trailer chassis	Ground stake.
				Internal cables (receiver-transmitter cabinet)	
W1104		2	7½	Left-side wall of transmitter compartment (J1117).	Trigger amplifier (J1151).
W1105		2	7½	Left-side wall of transmitter compartment (J1116).	Rear wall of transmitter compartment (R1108).
W1106		2	1	Trigger amplifier (J1152)	Grid of V1104.
W1504		1	1½	Duplexer (J1501)	IF amplifier (J1201).
W1505			11¾	Duplexer (J1502)	IF amplifier (J1202).
W1506			10½	Duplexer (J1503)	Afc assembly (J1301).
W1507			9¾	Afc assembly (J1302)	IF amplifier (J1204).
W1508			9¾	IF amplifier (J1206)	Stc assembly (J4702).
W1509		1	8	Stc assembly (J4701)	Right-side wall of receiver compartment (J1105).
W2001		1	7½	Right-side wall of receiver compartment (J1104).	Rear wall of receiver compartment (P2004).
W2002		1	11½	Rear wall of receiver compartment (P2008).	Right-side wall of receiver compartment (J1111).
W2003		1	¾	Rear wall of receiver compartment (P2005).	Left-side wall of receiver compartment (J2014).
W2004		1	8¾	Left-side wall of receiver compartment (J2015).	IF amplifier (J1207).
W2005		3	5½	Stc assembly (J4705)	Rear wall of receiver compartment (P2006).
W2006		4	½	Right-side wall of receiver compartment (J1112).	Rear of control-monitor panel (J1402).
W2007		4	10	Rear of control-monitor panel (J1404)	IF amplifier (J1208).

[a] Waveguide section.
[b] Shielded cable.

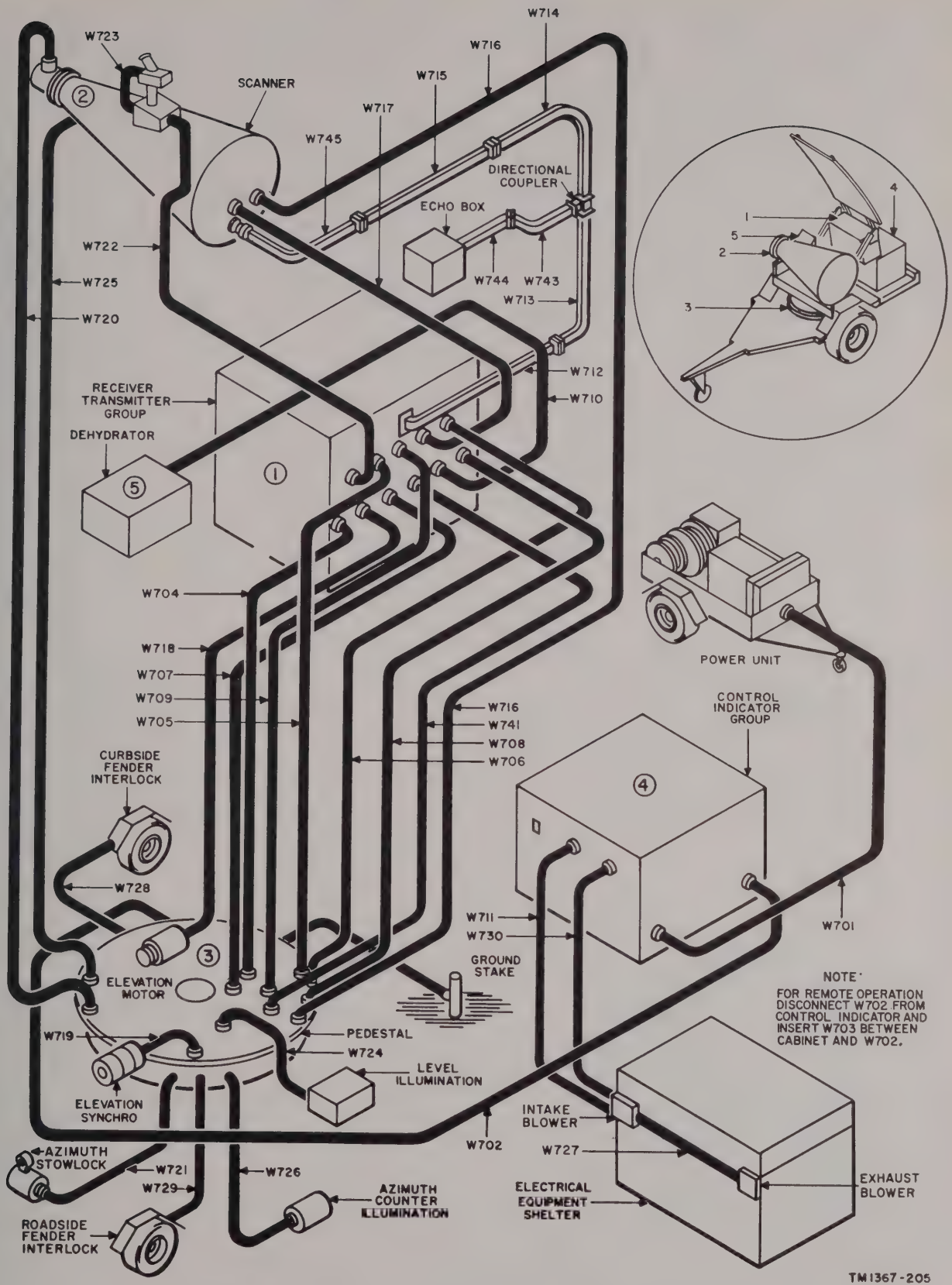

Figure 16. Radar Set AN/MPQ–4A, pictorial cabling diagram.

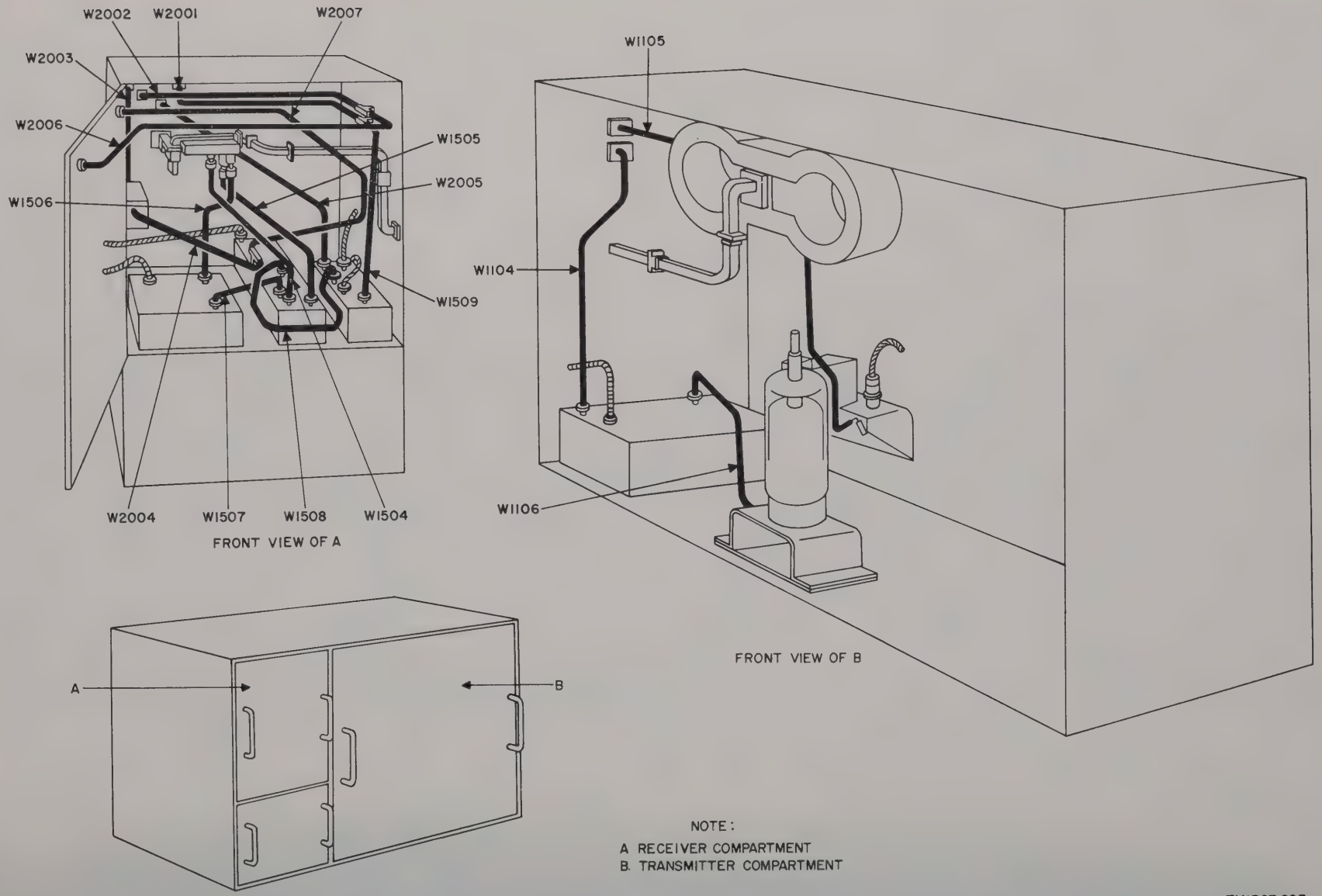

Figure 17. Receiver-transmitter group, internal cable connections.

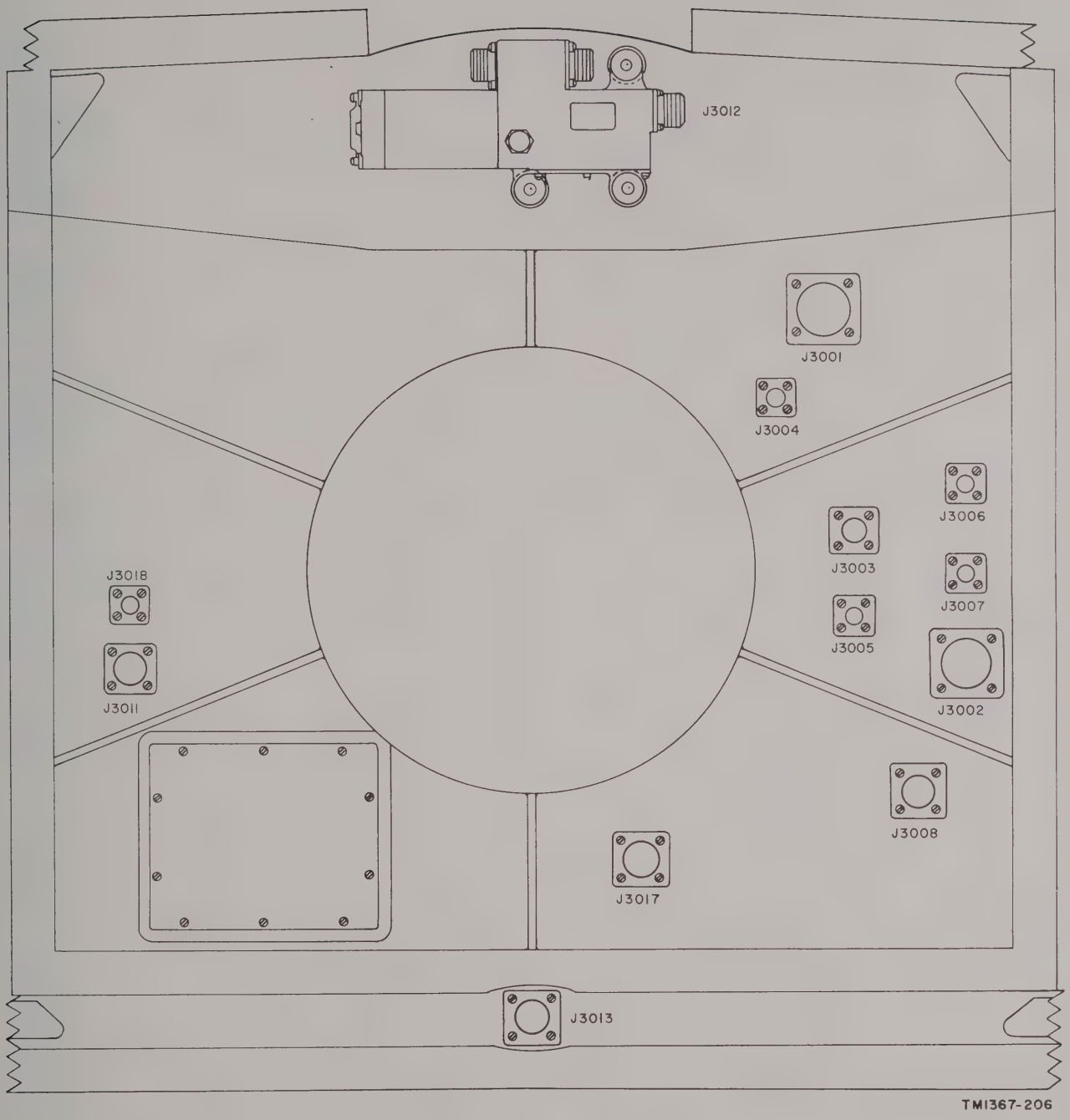

Figure 18. Pedestal, top view showing cable connections.

Section II. INSTALLATION ALINEMENT PROCEDURES

36. General

a. This section covers initial checks and alinement procedures that must be performed on Radar Set AN/MPQ–4A after installation and prior to initial operation. Adjustments made during operation are outlined in chapter 3.

b. The alinement procedures to be performed after initial installation, or after a long haul, include the orientation of the antenna group, the computer, and the indicator B-scope.

c. When the equipment has been installed after a short haul, only the orientation of the antenna group is necessary.

37. Initial Checks

a. Look for obvious damage, such as cracked glass, bent panels, or frayed cables.

b. Check all cables to be sure they are connected securely (par. 35).

c. Check all drawers for ease in sliding and locking.

d. Examine each drawer and make sure all tubes and tube shields are in place.

e. Check all front panel controls for ease of operation.

f. Check to see that the reflector is securely locked in its operating position (par. 31*c*).

g. Check to see that the brakes are set on both trailers and that the wheels are blocked on the radar trailer.

38. Power Unit Check

a. Since the installation of the power unit trailer may affect the operation of the power unit, refer to paragraph 30 for trailer installation instructions.

b. Check the amount of gasoline in the tank, measure the oil in the crankcase, and check the radiator for proper coolant mixture, depending upon climatic conditions.

c. Check to see that the three-phase ac supply circuit is Wye-connected (TM 5–5264).

d. Check all cable and plug connections.

e. Start the power unit (TM 5–5264) and check the output voltage at the power unit terminal posts. The output voltage should be 123 (±3) volts ac, 400 cps.

f. On control-power supply panel (fig. 26), turn the POWER UNIT switch to the START position. The POWER UNIT indicator lamp should light.

g. Check for battery charging current on the ammeter.

h. Turn the power unit off and place the IGNITION MANUAL START-REMOTE START switch in the REMOTE START position.

39. B-Scope Alinement

a. Start the equipment as outlined in paragraph 51.

b. Set the VIDEO control at maximum and the IF GAIN control at minimum.

c. With the RANGE SELECTOR switch (fig. 25) in the 10000 M position, adjust the INTENSITY control for desired brightness of the raster.

d. With the RANGE SELECTOR switch in the 2500 M position, adjust the INTENSITY BALANCE control (fig. 76) until the raster is at the threshold of visibility. (The PLOTTER DIMMER indicator lamp is at normal brightness.)

e. Adjust the FOCUS control for sharpest lines and images.

f. Turn the VIDEO control fully clockwise for maximum brightness of echo signals.

g. Adjust the IF GAIN control until the background noise is just noticeable.

h. Adjust the RANGE MARK control until the range strobe line is visible.

i. Adjust the AZIMUTH MARK control until the azimuth strobe line is visible.

j. With the MARKERS ON switch in the ON position, adjust the RANGE ZERO control until the 2,000-meter range calibration line coincides with the range line when the computer is set to 2,000-meters.

k. Adjust the RANGE SLOPE control until the 8,000-meter range calibration line coincides with the range line when the computer is set to 8,000 meters.

l. Repeat the steps in *j* and *k* above. If the presentation does not fill the screen, refer to paragraph 90*j* for further adjustment.

m. Check to see that the LOWER BEAM AZIMUTH control (fig. 28) on the computer moves the vertical strobe line horizontally across the face of the B-scope.

n. Check to see that the LOWER BEAM RANGE control on the computer moves the horizontal strobe line vertically across the face of the B-scope.

o. Turn the RANGE SHIFT switch to ON and check for a second range and strobe line with a displacement of approximately 500 meters.

p. Refer to paragraph 90 for further adjustments if the indicator is not operating properly.

40. Computer Alinement and Check

a. Check the linearity between the antenna elevation counter and the computer LOWER BEAM ELEVATION counter (fig. 28) as follows:

(1) Use the ELEVATION RAISE-LOWER switch on the control-power supply panel (fig. 27) to position the antenna to zero elevation as indicated on the pedestal counter, (fig. 19).

(2) Check to see that the computer LOWER BEAM ELEVATION counter (fig. 28) also indicates zero elevation after completing the step in (1) above.

(3) If the indications are not identical, complete the steps in (4) and (5) below.

(4) Pull out the computer drawer and, on the left side of the drawer, locate elevation adjustment B822 (fig. 20).

(5) Turn the adjustment screw until the reading on the computer counter corresponds to the antenna elevation counter reading.

(6) Check the computer LOWER BEAM ELEVATION counter and the pedestal counter at -100, -50, 0, $+50$, $+150$, $+200$ mils positions. The indications should be accurate to within 2 mils of each other at each of these positions.

b. Check the reading on the antenna beam separation plate and the corresponding dial reading in the computer as follows:

(1) Open the computer drawer and, on the left-hand side, locate potentiometer R822 (fig. 20).

(2) Compare the dial reading with the information on the beam separation plate (fig. 1).

(3) If the dial reading is incorrect, loosen the clamps that hold the dial and twist the potentiometer until the correct reading is obtained.

c. Check the antenna azimuth counter and the computer AZIMUTH counter as follows:

(1) Set the antenna azimuth counter (fig. 1) to zero by using the counter hand-crank.

(2) Turn the RADAR LOCATION AZ ORIENT switch on the computer until the AZIMUTH counter reads zero.

Note. Do not disturb any of the computer controls during the next procedure.

(3) Press the AZIMUTH switch (fig. 27) on the control-power supply panel to its CW position, and rotate the antenna in 800-mil steps from 800 to 6,400 mils. If the antenna passes the specified azimuth positions, do *not* jog the antenna back in the opposite direction.

(4) At each of the 800-mil steps, check to see that the computer AZIMUTH counter corresponds to the reading on the antenna azimuth counter within 2 mils.

(5) Repeat (1) through (4) above; rotate the antenna counterclockwise and stop at the same azimuth positions.

d. Check the computer azimuth controls and the indicator B-scope as follows:

(1) Set the detent switch (fig. 28) to OFF.

(2) Rotate the LOWER BEAM AZIMUTH control clockwise. The AZIMUTH counter reading increases and the B-scope azimuth strobe line moves to the right.

(3) Rotate the LOWER BEAM AZIMUTH control counterclockwise. The AZIMUTH counter reading decreases and the B-scope azimuth strobe line moves to the left.

(4) Set the detent switch to DETENT RELEASE and check to see that the two SET DETENT lights are on.

(5) Rotate the △ AZIMUTH control clockwise. The AZIMUTH counter reading decreases and the B-scope azimuth strobe line moves to the right.

(6) Rotate the △ AZIMUTH control counterclockwise. The AZIMUTH counter reading increases and B-scope azimuth strobe line moves to the left.

e. Check the computer range controls and the indicator B-scope as follows:

(1) Rotate the LOWER BEAM RANGE control clockwise. The RANGE counter reading increases and the B-scope range strobe line moves up.

(2) Rotate the LOWER BEAM RANGE control counterclockwise. The RANGE counter reading decreases and the B-scope range strobe line moves down.

(3) Turn the indicator RANGE MARK control to ON.

(4) Check the corresponding readings on the RANGE counter at 2,000-meter intervals on the B-scope.

(5) Set the detent switch to DETENT RELEASE and check to see that the two SET DETENT lights are on.

(6) Rotate the △ RANGE control clockwise. The RANGE counter reading decreases and the B-scope strobe line moves up.

(7) Rotate the △ RANGE knob counterclockwise. The RANGE counter reading increases and the B-scope range strobe line moves down.

f. Check the RADAR HEIGHT counter by rotating its adjustment screw; note that the counter reading changes. The weapon HEIGHT counter reading should also change by the same amount.

g. Check the weapon HEIGHT counter by rotating the control knob; note that the reading changes on the HEIGHT counter only.

h. Check the RADAR LOCATION counters as follows:

(1) Hold the RADAR LOCATION EASTING switch in the SUBT position; the counter reading decreases.

(2) Hold the RADAR LOCATION EASTING switch in the ADD position; the counter reading increases.

(3) Repeat (1) and (2) above with the RADAR LOCATION NORTHING switch and counter.

(4) Repeat (1) and (2) above with the RADAR LOCATION AZ ORIENT switch; observe the AZIMUTH counter.

i. Check the linearity between the computer AZIMUTH counter reading and the movement of the azimuth strope line as follows:

(1) With the radar set radiating (par. 51), press the ELEVATION switch (fig. 27) to the RAISE or LOWER position until a suitable electrical target (par. 41) is observed on the B-scope. If necessary, actuate the AZIMUTH switch to rotate the antenna and pick up the desired target.

(2) Set the computer detent switch to the OFF position and rotate the LOWER BEAM AZIMUTH control until the azimuth strobe line bisects the target on the B-scope. Note the reading on the computer AZIMUTH counter.

(3) Actuate the AZIMUTH switch to CW or CCW to change the antenna azimuth and move the target on the B-scope to a different position.

(4) Rotate the LOWER BEAM AZIMUTH control until the azimuth strobe line again bisects the target. The computer AZIMUTH counter reading should be the same as the reading noted in (2) above.

j. Check the AZIMUTH ORIENT indi ator lamp as follows:

(1) Put the △ RANGE and △ AZIMUTH controls in detent.

(2) Set the detent switch to AZIMUTH ORIENT and rotate the LOWER BEAM AZIMUTH control until detent is reached.

(3) The AZIMUTH ORIENT indicator lamp will light and the B-scope azimuth strobe line will be lined up with the center of the lower beam.

k. Check the △ TIME counter by rotating its control clockwise to increase reading and counterclockwise to decrease reading.

l. Adjust the DIMMER control to set the correct intensity of light on the computer panel.

m. Check the accuracy of the computer by solving the three test problems given below. For these problems, beam separation is set at 35 mils (*b* above); weapon height and radar height are set at 304.8 meters. Use the values listed for problem No. 1 in the table in (16) below and proceed as follows:

(1) Set △ T into the computer with the control located beneath the △ TIME counter.
(2) Set radar height into the computer with the control located beneath the HEIGHT counter.
(3) Set the detent switch to OFF.
(4) Rotate the △ RANGE and △ AZIMUTH controls to their detent position.
(5) Return RADAR LOCATION EASTING and RADAR LOCATION NORTHING counters to zero.
(6) Rotate the LOWER BEAM RANGE control to set the range reading into the RANGE counter.
(7) Operate the AZIMUTH switch (fig. 27) to set the azimuth reading into the AZIMUTH counter.
(8) Operate the ELEVATION RAISE LOWER switch to set the elevation reading into the LOWER BEAM ELEVATION counter.
(9) Turn the TEST NORMAL switch (fig. 21) to the TEST position.
(10) Set the detent switch to DETENT RELEASE.
(11) Rotate the △ RANGE control to set the △ R reading into the RANGE COUNTER.
(12) Rotate the △ AZIMUTH control to set the △ A reading into the AZIMUTH counter.
(13) Turn the TEST-NORMAL switch to the NORMAL position.
(14) Check the WEAPON LOCATION EASTING and NORTHING counter readings obtained against the answers given in the problem table.
(15) Repeat (1) through (14) above for the second and third problems.
(16) The northing and easting solutions should have no error greater than a 17.5 meter radial error.

Problem No.	ΔT	Radar height	Range	Azimuth	El	ΔR	ΔA	Weapon location	
								EASTING	NORTHING
1	0	137	3,000	200	−35	3,100	205	596.36	2973.7
2	0	0	2,500	2,000	50	2,900	1,990	3,205	98758
3	0	91	2,500	3,200	50	2,600	3,215	99,887.15	97226.2

n. Obtain a grid coordinate map and determin the location of the radar site. Insert the radar location information into the RADAR LOCATION EASTING and NORTHING counters. Obtain the height of the radar site from a contour map and insert this information into the RADAR HEIGHT counter. Set the same height into the weapon HEIGHT counter.

41. Antenna Azimuth Orientation

Two methods of orienting the antenna in azimuth are given below. The first method employs a known electrical target and should be used whenever possible. The second method makes use of an optical target and will permit azimuth orientation of the antenna with a reasonable degree of accuracy.

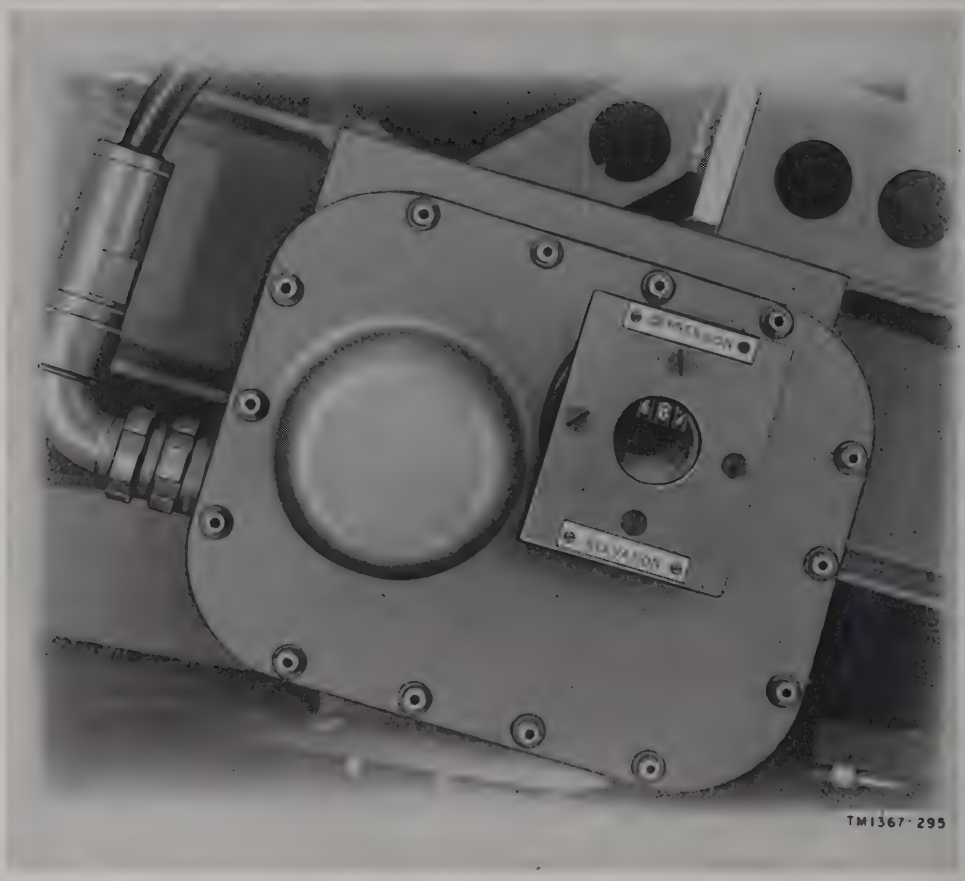

Figure 19. Antenna elevation counter.

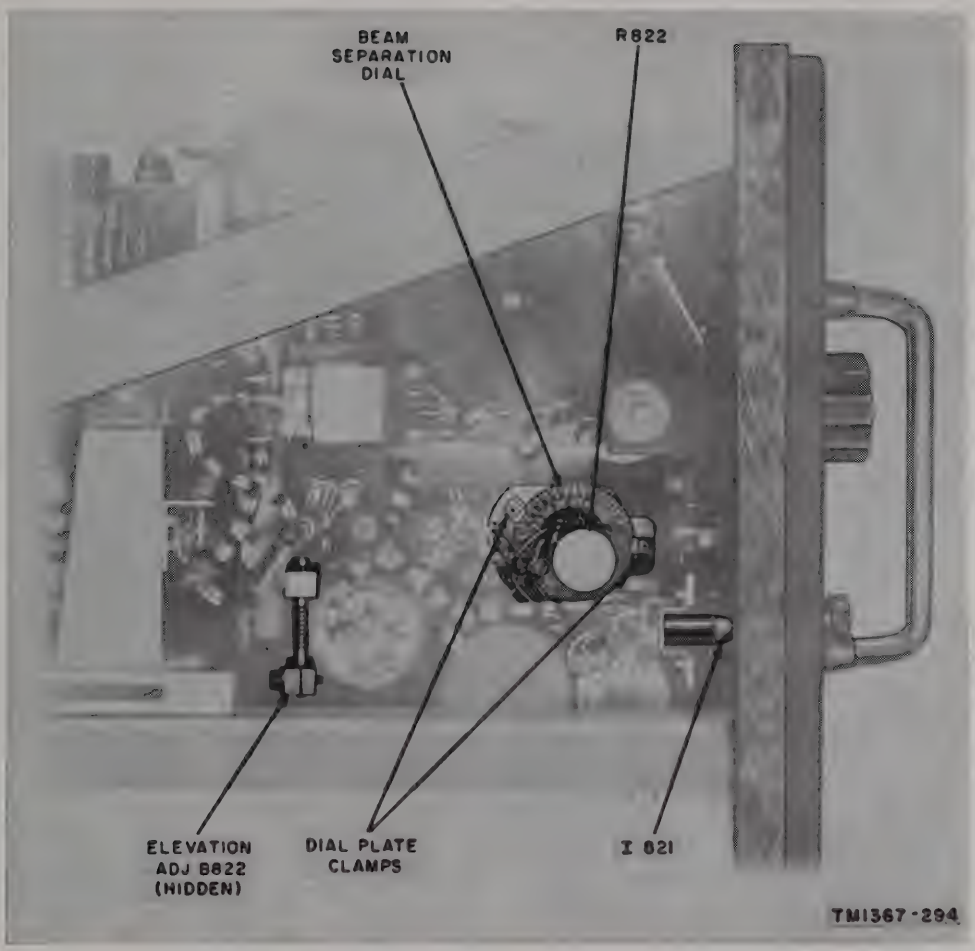

Figure 20. Computer drawer, partial left-side view.

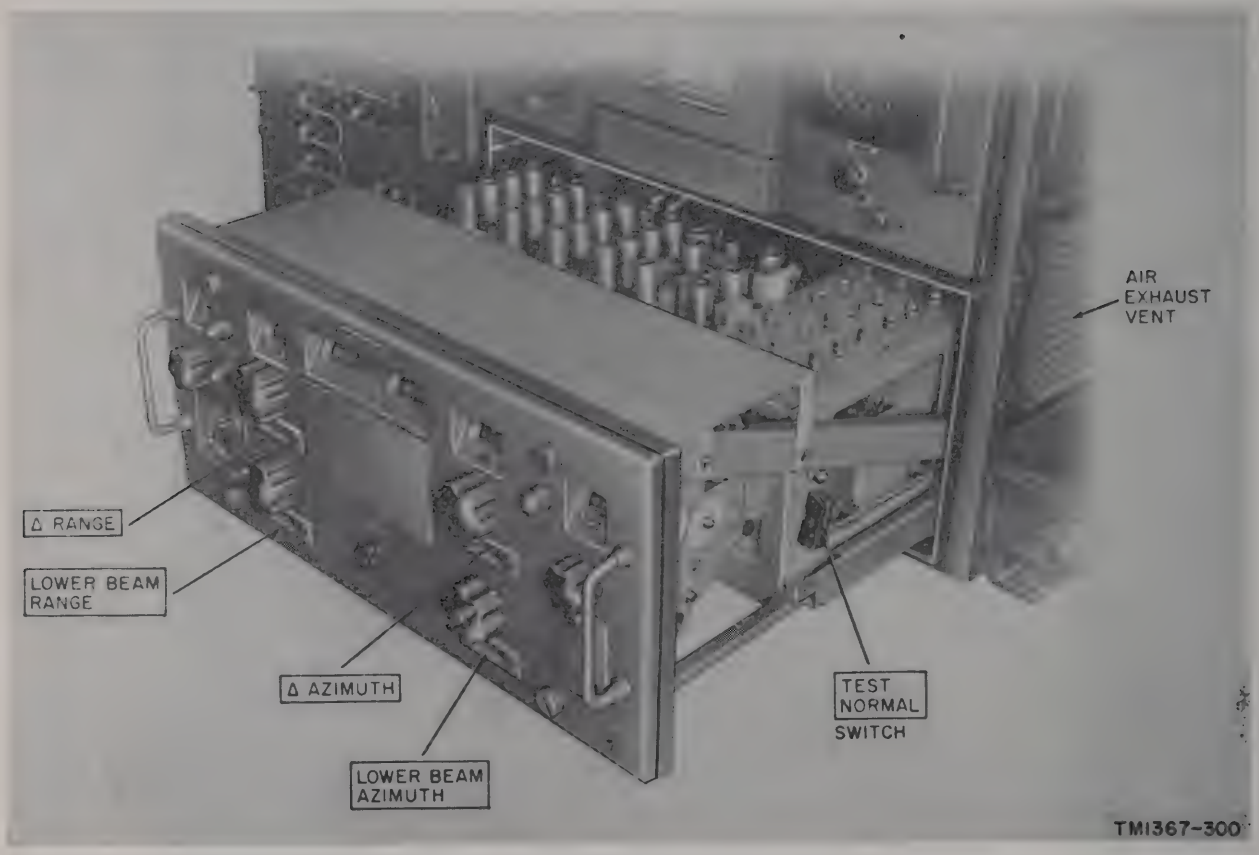

Figure 21. Computer, right oblique view, drawer pulled out from cabinet.

a. Azimuth Orientation of Known Electrical Target. The radar set is radiating and the azimuth of the electrical target is known when this method is used.

(1) On the control-power supply panel (fig. 26), turn the MAIN POWER switch to ON. Wait 5 minutes for the READY indicator lamp to light.

(2) Press the START button. The RADIATE indicator lamp will light.

(3) Press the ELEVATION switch to the RAISE or LOWER position until a suitable electrical target is observed on the B-scope. A suitable electrical target is one that will give a clearly defined pip on the B-scope; for example, a water tank or any other object on the horizon not associated with a group of buildings. It may be necessary to actuate the AZIMUTH switch and rotate the antenna in order to pick up the desired target.

(4) On the computer (fig. 28), set the detent switch to OFF and place the △ AZIMUTH control in its detent position.

(5) Rotate the LOWER BEAM AZIMUTH control until the azimuth strobe line bisects the pip of the electrical target on the B-scope.

(6) Turn the RADAR LOCATION AZ ORIENT switch until the AZIMUTH counter reads the azimuth of the known electrical target.

(7) Set the antenna azimuth counter (fig. 1) to read the correct azimuth.

Note. The antenna azimuth counter is provided for use during remote operation when the control-indicator group is located away from the radar trailer. During local installation and operation, the computer AZIMUTH counter is used to determine the azimuth angle of the antenna.

b. Azimuth Orientation on Optical Target. The azimuth of the optical target is known when this method is used. The radar set is not radiating.

(1) On the control-power supply panel (fig. 26), turn the MAIN POWER switch to the ON position. Wait 5 minutes for the READY indicator lamp to light.

(2) Turn the azimuth drive hand wheel (fig. 11) to rotate the antenna until the vertical cross hair of the telescope intercepts a visual target of known azimuth.

(3) On the computer (fig. 28), set the detent switch to AZIMUTH ORIENT and place the △ AZIMUTH and LOWER BEAM AZIMUTH controls in their detent position.

(4) Obtain the frequency of the radar set from the daily record sheet (par 69). Refer to the frequency correction chart (fig. 22) to determine the field correction to be applied. Interpolate if necessary.

(5) Apply the FIELD correction to the azimuth of the known optical target.

(6) Turn the RADAR LOCATION AZ ORIENT control on the computer until the AZIMUTH counter reads the corrected azimuth of the optical target obtained in (5) above.

(7) Set the antenna azimuth counter (fig. 1) to read the actual target azimuth.

(8) When (1) through (7) above have been completed, rotate the antenna until an electrical target is sighted on the B-scope. Use the LOWER BEAM AZIMUTH control to bisect the pip of the electrical target and obtain a reading on the AZIMUTH counter. Record the azimuth of the electrical target for future use (i. e., during darkness).

AZIMUTH BORE SIGHT CORRECTION	
FREQUENCY	FIELD
16192	+12
16176	+11
16160	+10
16144	+9
16128	+8
16112	+7
16096	+6
16080	+5
16064	+4
16048	+3
16032	+2
16016	+1
16000	0
15984	−1
15968	−2
15952	−3
15936	−4
15920	−5
15904	−6
15888	−7
15872	−8
15856	−9
15840	−10
15824	−11
15808	−12

TM1367-227

Figure 22. Frequency correction chart.

CHAPTER 3
OPERATING INSTRUCTIONS

Section I. CONTROLS AND INSTRUMENTS

42. General

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control. The actual operation of the equipment is discussed in paragraphs 49 through 56.

43. Control-Monitor C–2102/MPQ–4A (fig. 23)

The table below lists the controls, instruments, test jacks, and outlets of the control-monitor on the receiver-transmitter group and the functions of each item.

Control	Function
H V P S CURRENT TEST jack.	For maintenance use only.
OUTPUT PULSE TEST jack.	For maintenance use only.
120V 400 ~ outlet	For maintenance use only.
VIDEO TEST jack	For maintenance use only.
AFC OUTPUT jack	For maintenance use only.
MAGNETRON CUR meter.	Indicates magnetron current.
TEST METER	Indicates crystal currents or low-voltage power supply voltages.
MAGNETRON HOURS meter	Indicates number of hours of magnetron operation.
TEST METER SELECTOR switch	A six-position wafer switch which connects the meter to various circuits in the receiver and power supply.
	Position — *Function*
	XTAL 1 — Indicates current in IF crystal No 1 (CR1501).
	XTAL 2 — Indicates current in IF crystal No. 2 (CR1502).
	AFC XTAL — Indicates current in afc crystal (CR1503).
	+300 V X100 — Indicates output voltage of +300-volt supply for afc and stc assemblies.
	+150 V X50 — Indicates output voltage of +150-volt supply for afc and IF assemblies.
	−300 V X100 — Indicates output voltage of −300-volt supply for afc and stc assemblies.
L. O. CAVITY RAISE-LOWER switch.	Adjustment for varying frequency of local oscillator V1501.
A. F. C.-MANUAL switch.	Selects either MANUAL or A. F. C. operation or local oscillator frequency.

44. Power Supply PP–1588/MPQ–4A (fig. 24)

The table below lists the instruments of the power supply in the receiver-transmitter group and the function of each item.

Control	Function
.125 AMP fuse	Protects the +300-volt dc supply.
.250 AMP fuse	Protects the +300-volt dc supply.
.062 AMP fuse	Protects the −300-volt dc supply.
+300 V DC indicator lamp.	Indicates blown fuse in the +300-volt dc supply.
+150 V DC indicator lamp.	Indicates blown fuse in the +150-volt dc supply.
−300 V DC indicator lamp.	Indicates blown fuse in the −300-volt dc supply.
SPARE 125 AMP fuse	Spare fuse for the +300-volt dc supply.
SPARE .250 AMP fuse	Spare fuse for the +150-volt dc supply.
SPARE 062 AMP fuse	Spare fuse for the −300-volt dc supply.

45. Azimuth and Range Indicator IP–375/MPQ–4A (fig. 25)

The table below lists the controls and instruments of the indicator and the function of each item.

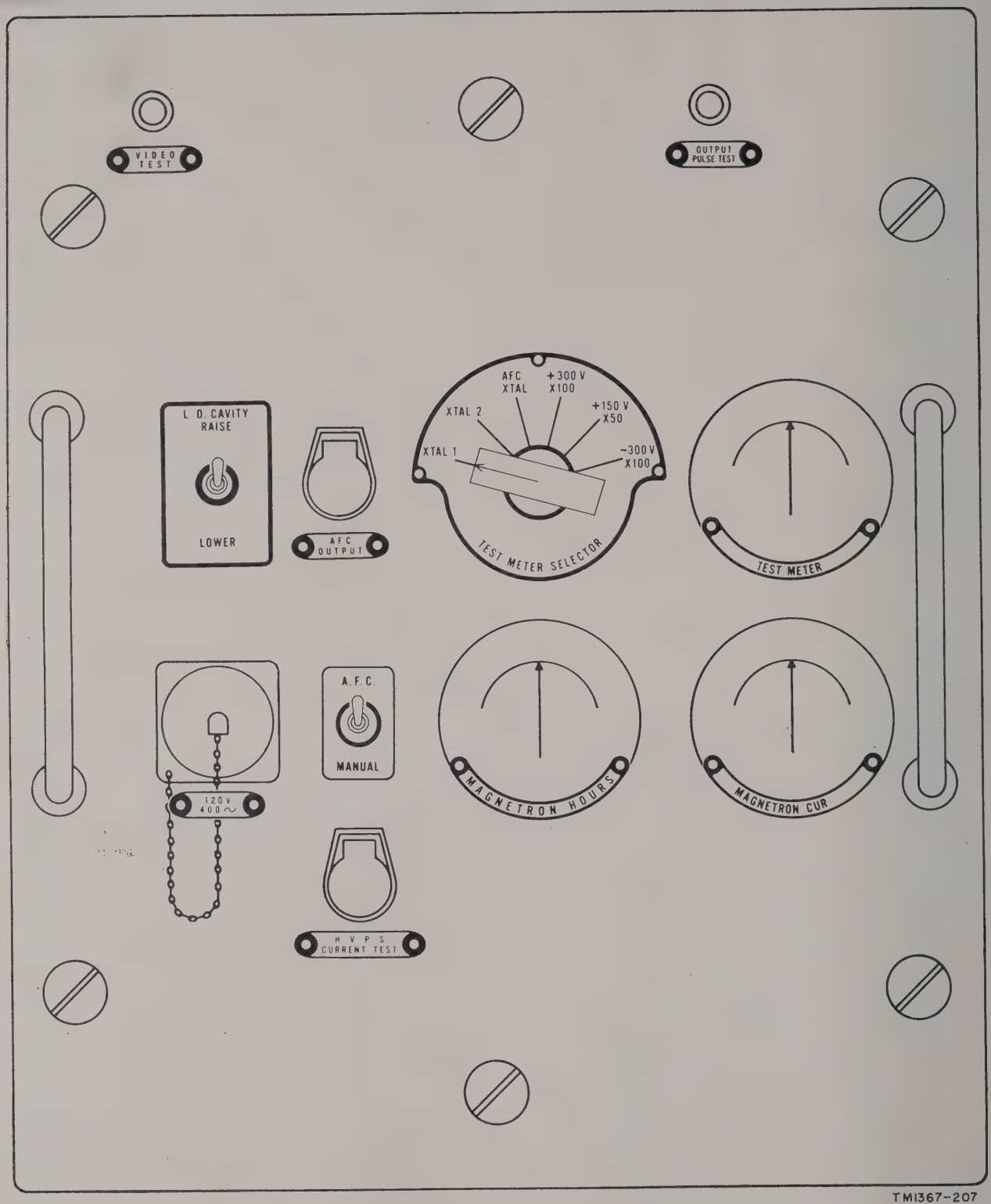

Figure 23. Control-Monitor C–2102/MPQ–4A, front panel.

Control	Function
SET DETENT indicator lamp.	Indicates that computer Δ RANGE and Δ AZIMUTH controls are not in detent.
SECONDS timer	Indicates time interval between first and second actuation of TIMER button.
VIDEO control	Adjusts video gain.
RANGE MARK control	Adjusts range mark intensity.
IF GAIN control	Varies sensitivity of receiver.
PLOTTER DIMMER control.	Varies brightness of plotter illumination.
RANGE ZERO adjustment.	Maintenance adjustment only.
RANGE SLOPE adjustment.	Maintenance adjustment only.
FOCUS control	Adjusts the focus of the electron beam.
AZIMUTH MARK control.	Adjusts the intensity of azimuth mark.
PANEL DIMMER control.	Varies illumination of front panel control marking.
INTENSITY control	Adjusts the brightness of the screen.
RANGE SELECTOR switch.	Sets indicator for 10000 M or 2500 M range.
RANGE SHIFT switch	In ON position, displaces the upper beam from the lower beam by 500 meters for easy viewing of in-flight target. In off position, indicator functions as straight radar.
MARKERS ON switch	Inserts 2,000-meter marks for range calibration.
TIMER switch (left	Momentary push button to start or stop SECONDS timer. Also reverses the beam video when BEAM VIDEO selector switch is in either LOWER or UPPER position.
TIMER switch (right	Momentary push button to start or stop SECONDS timer. Also reverses the beam video when BEAM VIDEO selector switch is in either LOWER or UPPER position.
RESET switch	Push button used to return SECONDS timer to zero.
BEAM VIDEO selector switch.	In UPPER position, selects the video from the upper beam for B-scope display. In LOWER position, selects the video from the lower beam. In BOTH position, selects the video from both beams.
EXPANDED SWEEP DELAY X–1000 M switch.	Places the center of the 2500 M range anywhere on the 10000 M sector. Calibrated in 1,000-meter steps. Used to select 2,500-meter range sector for expansion.

46. Control-Power Supply C–2014/MPQ–4A (figs. 26 and 27)

The table below lists the controls and instruments of the control-power supply in the control-indicator group and the function of each item.

Control	Function
10 AMP fuse (upper)	Protects the 120-volt, line L1, ac supply to control-indicator group.
SPARE 10 AMP fuse	Spare for upper 10 AMP fuse.
10 AMP fuse (lower)	Protects the 120-volt, line L2, ac supply to the pedestal.
SPARE 10 AMP fuse	Spare for lower 10 AMP fuse.
20 AMP fuse	Protects the 120-volt, line L3, ac supply for magnetron power.
SPARE 20 AMP fuse	Spare for 20 AMP fuse.
.5 AMP fuse	Protects the +220-volt dc supply to the indicator.
SPARE .5 AMP fuse	Spare for .5 AMP fuse.
.25 AMP fuse	Protects the +220-volt dc supply to the computer.
SPARE .25 AMP fuse	Spare for .25 AMP fuse.
.125 AMP fuse	Protects the 220-volt dc supply to the indicator.
SPARE .125 AMP fuse	Spare for .125 AMP fuse.
5 AMP fuse (F661)	Protects the +27-volt dc supply.
SPARE 5 AMP fuse	Spare for 5 Amp fuse.
120 V AC indicator lamp.	Indicates blown fuse (upper 10 AMP) for the 120-volt, line L1, ac supply to the control-indicator group.
120 V AC indicator lamp.	Indicates blown fuse (20 AMP) for the 120-volt, line L2, ac supply to the pedestal.
120 V AC indicator lamp.	Indicates blown fuse (lower 10 AMP) for the 120-volt, line L3, ac supply for magnetron power.
120 V AC indicator lamps (three).	Left lamp indicates blown fuse for 120-volt, line L1A, ac supply to the computer and pedestal. Center lamp indicates blown fuse for the 120-volt, line L2A, ac supply to the computer and pedestal. Right lamp indicates blown fuse for the 120-volt, line L3A, ac supply to the computer and pedestal.
440 V DC indicator lamp.	Indicates blown fuse for the +440-volt dc supply to the indicator.
+220 V DC IND indicator lamp.	Indicates blown fuse for the +220-volt dc supply to the indicator.
+220 V DC COMPUTER indicator lamp.	Indicates blown fuse for the +220-volt dc supply to the computer.
−220 V DC IND indicator lamp.	Indicates blown fuse for the −220-volt dc supply to the indicator.
POWER UNIT indicator lamp.	Indicates power unit has started and that phase sequence of three-phase ac supply is correct.

Control	Function
RADIATE indicator lamp.	Indicates transmitter is operating.
READY indicator lamp	Indicates 5-minute magnetron delay period is completed and high voltage may be applied.
+27 V DC indicator lamp.	Indicates blown fuse for 27-volt dc supply.
MAIN POWER ON & INTLK CLOSED indicator lamp.	Indicates that computer and indicator interlocks are closed and ac is being applied to the control-indicator group.
MAGNETRON CURRENT meter.	Indicates magnetron current.
TEST METER	Indicates the operating dc voltages for the indicator and the afc crystal current in the receiver.
TEST METER SELECTOR switch.	A six-position wafer switch which connects the meter to various circuits in the control-power supply and receiver.
	Position — *Function*
	OFF — Disconnect TEST METER from circuits.
	440 V X100 — Indicates +440-volt output supply for indicator.
	220 V X50 — Indicates +220-volt output supply for indicator.
	27 V X10 — Indicates +27-volt output supply.
	−220 V X50 — Indicates −220-volt output supply for indicator.
	AFC XTAL CUR — Indicates current in afc crystal (CR1503).
MAIN POWER switch	Controls application of main power to the complete radar set.
POWER UNIT switch	Starts or stops remote Gasoline Engine Generator Set PU–107A/U.
L. O. switch	Press the switch to RAISE position to increase the local oscillator frequency; press to LOWER position to decrease the frequency.
ELEVATION switch	Press the switch to RAISE position to raise antenna beam; press to LOWER position to lower antenna beam.
AZIMUTH switch	Press the switch to CW position to rotate antenna clockwise in azimuth; press to CCW position to rotate antenna counterclockwise in azimuth.
AFC-MANUAL switch	Maintains specified frequency of local oscillator when in AFC position. MANUAL position is used when adjustments are made with L. O. switch.
START switch	Push button to start the transmitter.
STOP switch	Push button to shut off transmitter.
MAGNETRON POWER variac.	Adjusts magnetron current for proper operation.

47. Radar Data Computer CP–319/MPQ–4A (fig. 28)

The table below lists the controls and instruments of the computer and the function of each item.

Control	Function
SET DETENT indicator lamp.	Lights when Δ RANGE and Δ AZIMUTH controls are not in detent.
DOUBTFUL SOLUTION indicator lamp.	Lights when problem exceeds the design limits of the computer.
AZIMUTH ORIENT indicator lamp.	Lights when LOWER BEAM AZIMUTH control is in detent and the B-scope strobe line is lined up with the center of the lower beam.
Δ TIME counter	Indicates time correction factor in seconds.
Weapon HEIGHT counter.	Indicates weapon height in meters.
RADAR HEIGHT counter.	Indicates height of radar set in meters.
WEAPON LOCATION EASTING and NORTHING counters.	Indicates map coordinates of weapon in meters.
RADAR LOCATION EASTING and NORTHING counters.	Indicates map coordinates of radar set in meters.
LOWER BEAM ELEVATION counter.	Indicates lower beam elevation angle in + or − mils.
RANGE counter	Indicates range of lower beam range strobe marker; also indicates computed range from radar to weapon site. Either value is given in METERS.
AZIMUTH counter	Indicates azimuth of lower beam azimuth strobe marker; also indicates computed azimuth of radar to weapon site. Either value is given in MILS.

Control	Function
Δ time control	Used to set the time interval between upper and lower beam echoes into the computer. This control is located directly below the Δ TIME counter.
Weapon height control	Used to set the weapon height into the computer. This control is located directly below the HEIGHT counter.
Δ RANGE control	Used to set the range of the upper beam intercept line into the computer.
LOWER BEAM RANGE control.	Used to set the range of the lower beam intercept into the computer.
Δ AZIMUTH control	Used to set the azimuth of the upper beam intercept into the computer.
LOWER BEAM AZIMUTH control.	Used to set the azimuth of the lower beam intercept into the computer.
DIMMER control	Controls brightness of panel lights.
RADAR HEIGHT adjustment.	Used to set the height of the radar set into the computer.
RADAR LOCATION EASTING switch.	Controls a slewing motor used to orient the RADAR LOCATION EASTING counter.
NORTHING switch	Controls a slewing motor used to orient the RADAR LOCATION NORTHING counter.
AZ ORIENT switch	Controls a slewing motor used to orient the AZIMUTH counter.
AZIMUTH ORIENT, OFF, DETENT RELEASE switch (detent switch).	A three-position switch which allows various controls to be set in or out of detent.

Position	*Function*
AZIMUTH ORIENT	Allows LOWER BEAM AZIMUTH control to be placed in detent.
OFF	Releases LOWER BEAM AZIMUTH control from detent.
DETENT RELEASE	Reseases Δ RANGE and Δ AZIMUTH controls from detent. (When this happens the SET DETENT lamp will light.)

48. Antenna Group OA–1258/MPQ–4A

The following table lists the controls and instruments on the antenna group and the function of each item.

Control	Function
Azimuth counter illumination control (fig. 39).	Controls intensity of azimuth counter lamp.
Elevation counter illumination control (fig. 39).	Controls the intensity of elevation counter lamp.
Level illumination control (fig. 39).	Controls the intensity of the level lamp.
Reticle illumination control (fig. 39).	Controls intensity of reticle lamp.
Azimuth stowlock (fig. 1).	Locks the pedestal to the trailer to prevent movement in azimuth during transit. Also opens the azimuth drive circuit when engaged.
Antenna azimuth counter (fig. 1).	Indicates the azimuth of the antenna in mils.
Azimuth hand wheel (fig. 11).	Drives the antenna manually when shaft is pushed all the way in. With shaft in midway position, antenna may be turned by hand. With shaft pulled all the way out, antenna is controlled by AZIMUTH switch on control-power supply panel.
ELEVATION-DEPRESSION counter (fig. 19).	Indicates the elevation or depression of the antenna in mils.
Spirit level (fig. 1)	Used in leveling the radar trailer.

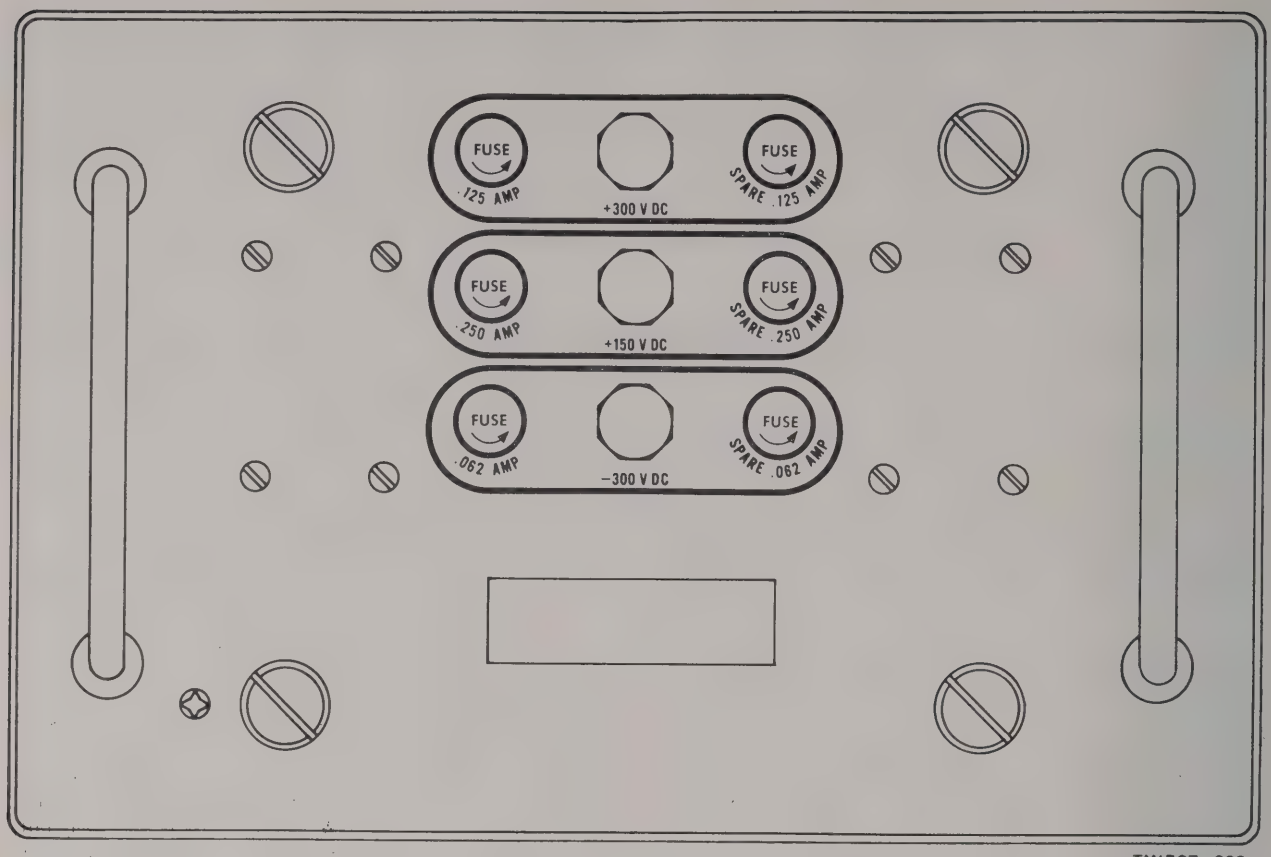

Figure 24. Power Supply PP–1588/MPQ–4A, front panel.

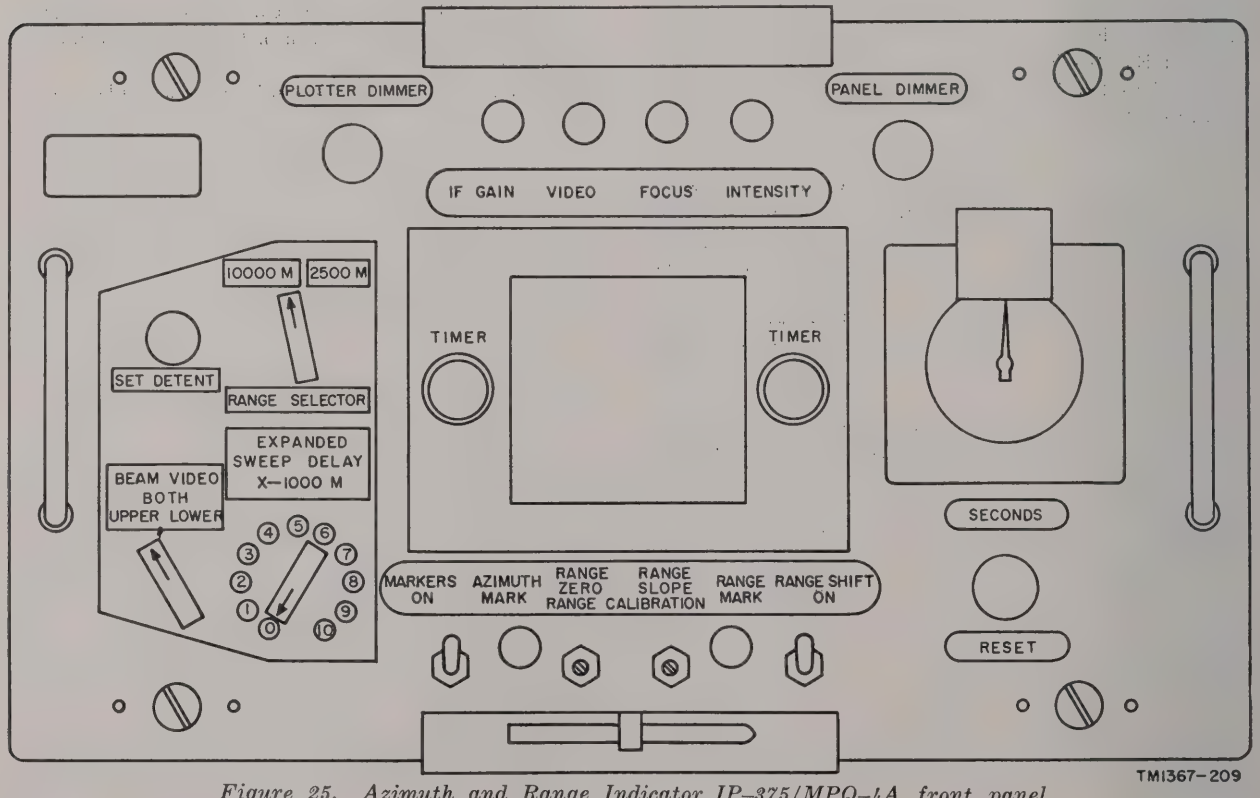

Figure 25. Azimuth and Range Indicator IP–375/MPQ–4A front panel.

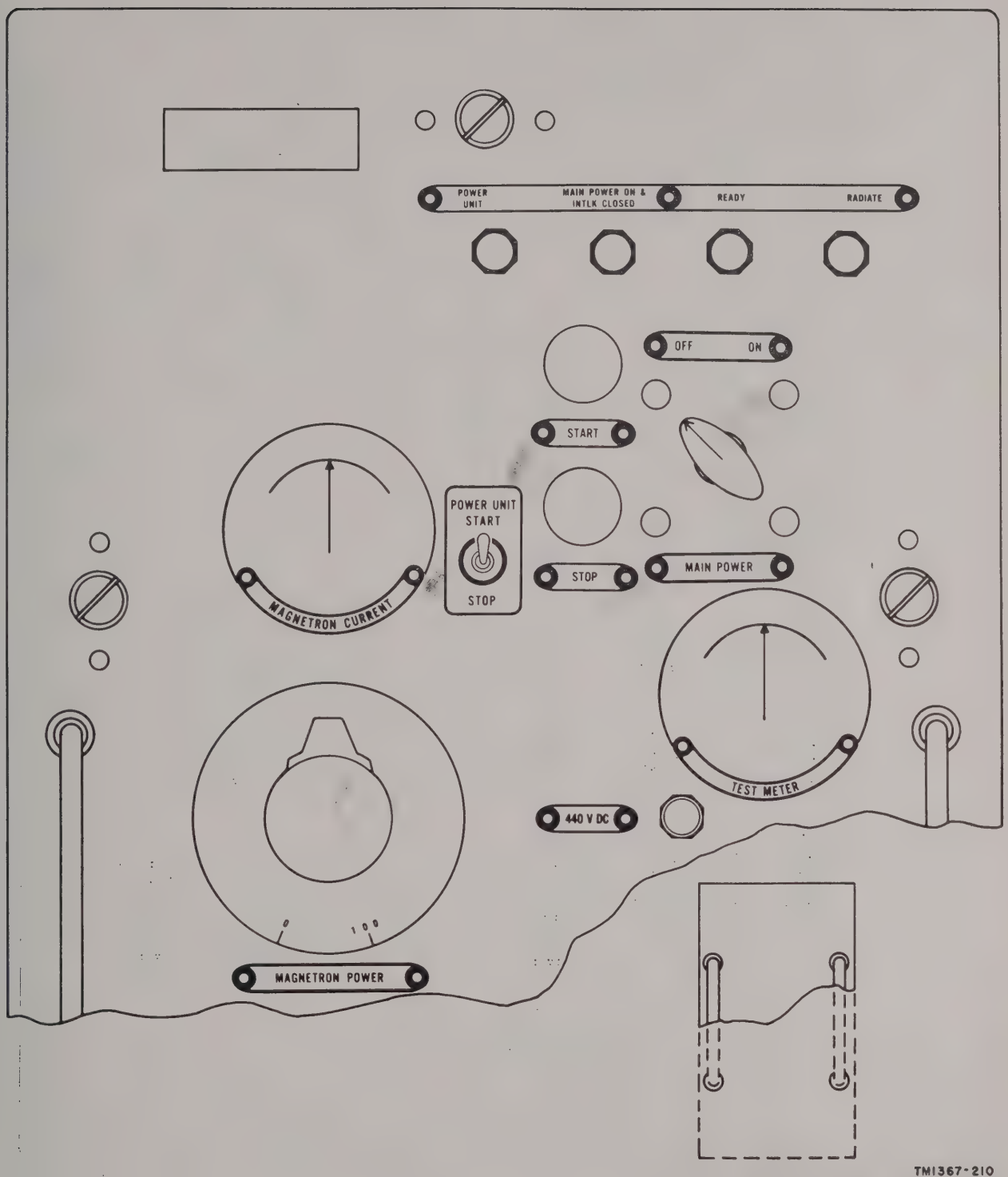

Figure 26. Control-Power Supply C–2014/MPQ–4A, upper half of front panel.

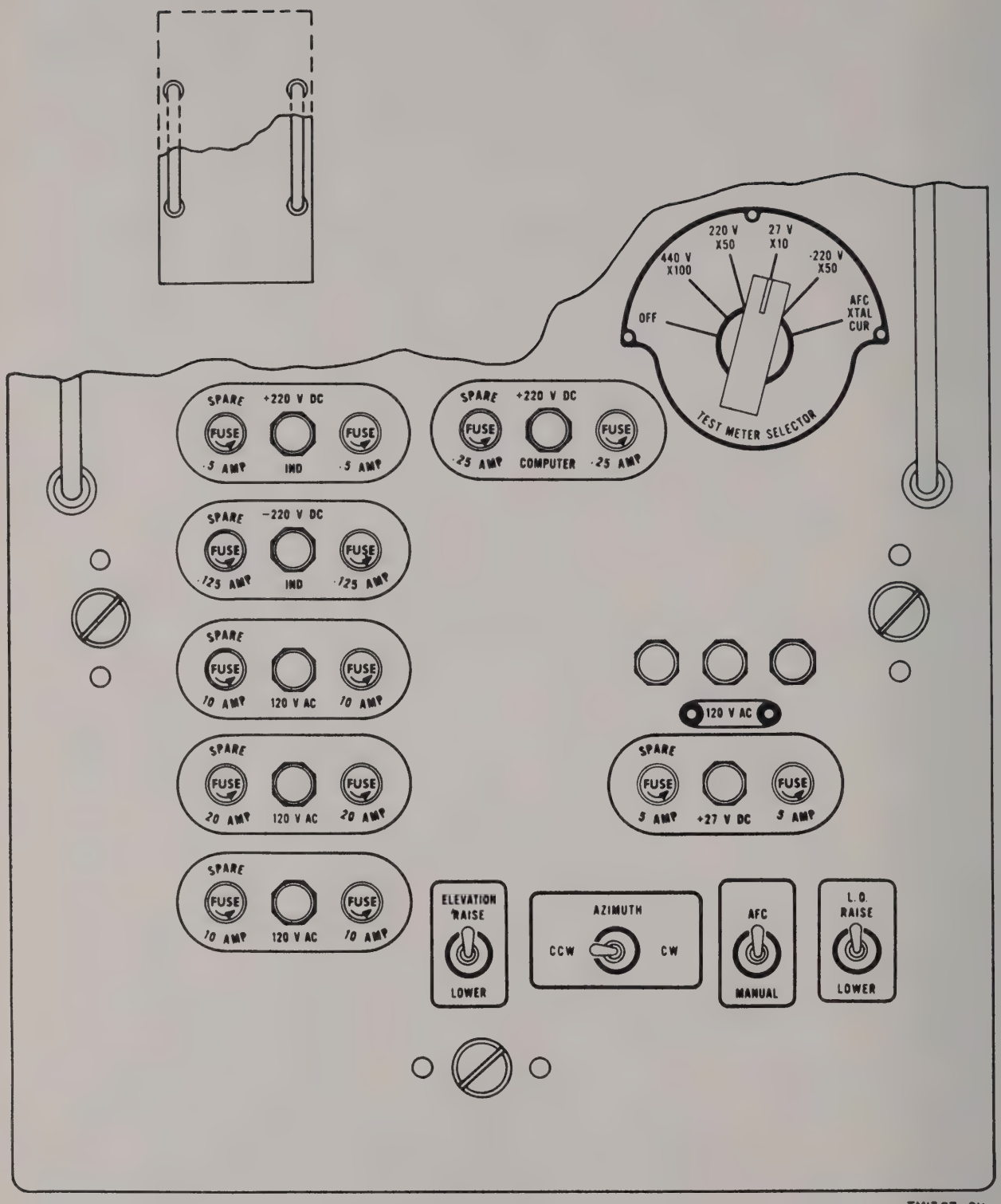

Figure 27. Control-Power Supply C–2014/MPQ–4A, lower half of front panel.

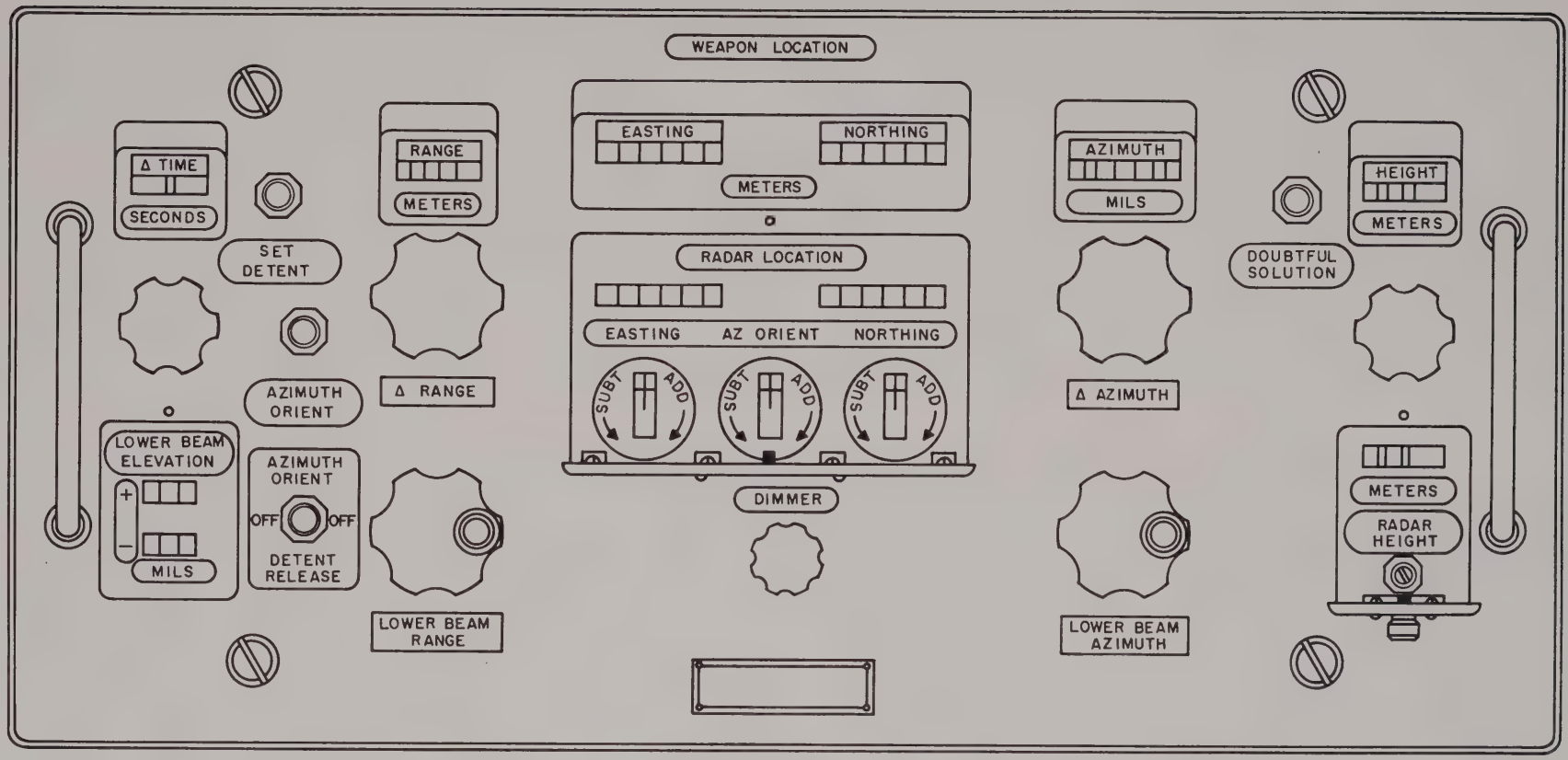

Figure 28. Radar Data Computer CP-319/MPQ-4A, front panel.

Section II. OPERATION UNDER USUAL CONDITIONS

49. Local and Remote Operation

Radar Set AN/MPQ–4A is designed for both local and remote operations. In local operation, the control-indicator group is mounted on the radar trailer. For remote operation, the control-indicator group may be moved to a maximum distance of 150 feet from the radar trailer. Refer to paragraph 34 for differences in cabling between the two types of operation. Preliminary adjustments and operating procedures are identical in either mode.

50. Preliminary Adjustments

Before power is applied to Radar Set AN/MPQ–4A, perform the following preliminary adjustments:

a. Receiver-Transmitter Group OA–1257/MPQ–4A. Set the A.F.C. MANUAL switch on the control-monitor panel to the A.F.C. position. All other operating controls for this component are located on the control-power supply panel in Control-Indicator Group OA–1256/MPQ–4A.

b. Control-Power Supply C–2014/MPQ–4A (figs. 26 and 27).

Control	Position
POWER UNIT switch	STOP
MAIN POWER switch	OFF
AFC-MANUAL switch	MANUAL
TEST METER SELECTOR switch	27 V position

c. Azimuth and Range Indicator IP–375/MPQ–4A (fig. 25).

Control	Position
PLOTTER DIMMER potentiometer	Fully counterclockwise
PANEL DIMMER potentiometer	Fully counterclockwise
EXPANDED SWEEP DELAY switch	5
RANGE SELECTOR switch	10000 M
BEAM VIDEO switch	BOTH
MARKERS ON switch	Off (down)
RANGE SHIFT switch	Off (down)
RANGE MARK potentiometer	Midposition
AZIMUTH MARK potentiometer	Midposition

d. Gasoline Engine Generator Set PU–107A/U.

Control	Position
ON-OFF switches	ON
IGNITION MANUAL START-REMOTE START switch	REMOTE START

e. Antenna Group OA–1258/MPQ–4A. At the antenna, insure that the azimuth stowlock (fig. 1) is off, the azimuth hand wheel (fig. 11) is pulled all the way out, and the trailer fenders are down. Be sure that the intake and outlet vents on the scanner (fig. 1) are open.

f. Interlock Circuits. Close the following interlocks to insure equipment operation:

(1) On the control-indicator group, secure the control-power supply, indicator, and computer drawers (closing switches S1001, S1003, and S1005). Hinge up the air intake and air exhaust panels on the left and right sides of the cabinet (closing switches S1007 and S1008).

(2) On the receiver-transmitter group, secure the control-monitor panel closing switch S2005), the power supply drawer (closing switch S2006), and the transmitter door (closing switches S1102, S1104, and S1106). Hinge up the air intake and air exhaust panels on the rear of the cabinet (closing switches S1108 and S2004), and the second air exhaust panel on the left-hand side (closing switch S2003).

(3) On the dehydrator, hinge up the air intake panel on the left-hand side of the front panel (closing switch S3301).

51. Starting Procedure

If an abnormal result is obtained during the starting procedure, refer to paragraph 65, operator's checklist. Refer to paragraph 50 before using this starting procedure.

Caution: Make sure all personnel are clear of the antenna before placing the radar set in operation.

a. Press the POWER UNIT switch (fig. 26) to the START position. The POWER UNIT indicator lamp will light.

b. Turn the MAIN POWER switch to the ON position (fig. 26). The MAIN POWER ON & INTLK CLOSED indicator lamp will light and the TEST METER on the control-power supply will indicate 27 volts. The indicator on the TEST METER will oscillate when the TEST METER SELECTOR switch is turned to AFC XTAL CUR position and the A.F.C. MANUAL switch is in the A.F.C. position.

c. After 30 seconds, check the B-scope for normal raster.

d. Check for operation of the system blowers.

(1) The main blower in the receiver-transmitter cabinet is operating if air is being discharged at the exhaust vent on the left-hand side of the cabinet.

Warning: Do not reach into the transmitter compartment during the following check. Voltage in excess of 30,000 volts is present.

(2) Check the magnetron blower in the receiver-transmitter cabinet. Open the transmitter compartment door. With the power on, a current of air will be felt from the magnetron, indicating blower operation.

(3) The control-indicator blower is operating if air is being discharged at the exhaust vent on the right-hand side of the cabinet.

e. While waiting for the 5-minute delay relay to close, perform the following checks and adjustments:

(1) After 30 seconds, rotate the TEST METER SELECTOR switch (fig. 27) through all its positions and check the voltages on the TEST METER. The following chart lists typical readings which should be obtained.

Switch position	Meter scale	Typical reading	Actual value
440 V X100	0–5	4.4	440 volts
220 V X50	0–5	4.4	220 volts
27 V X10	0–5	2.7	27 volts
−220 V X50	0–5	4.4	−220 volts
AFC XTAL CUR	0–5	2.5	.5 ma

(2) Operate the AZIMUTH switch (fig. 27) to the CW and then to the CCW position. The antenna should rotate correspondingly.

(3) Operate the ELEVATION switch. In the RAISE position, the reflector should tilt upward. In the LOWER position, the reflector should tilt downward.

(4) On the computer, set the controls as follows:

Control	Position
LOWER BEAM RANGE control	Set to 1500.
Δ RANGE control*	Set to detent or zero position.
Δ AZIMUTH control*	Set to detent or zero position.
Δ TIME control	Set to zero position.
RADAR LOCATION EASTING counter.	Refer to paragraph 40*n*.
RADAR LOCATION NORTHING counter.	Refer to paragraph 40*n*.
RADAR HEIGHT counter (screwdriver adjust)	Refer to paragraph 40*n*.
Weapon HEIGHT counter	Refer to paragraph 40*n*.

* When either the Δ RANGE or Δ AZIMUTH control is not in its detent position, the SET DETENT indicator lamp will light.

f. When the 5-minute delay period is over, the READY indicator lamp on the control-power supply panel will light.

g. Press the START button. The RADIATE indicator lamp will light.

h. Adjust the MAGNETRON POWER variac until the MAGNETRON CURRENT meter reads 22 ma.

i. On the indicator, turn the MARKERS ON switch to the ON position. When the local oscillator is properly tuned, the range markers will be visible in diminishing intensity at ranges of 2,000, 4,000, 6,000, 8,000, and 10,000 meters.

j. Operate the L. O. RAISE LOWER switch on the control-power supply panel to the RAISE and then to the LOWER position until maximum video return is obtained on the indicator B-scope. Two such points will be found. The point *lower* in frequency (observed with the L. O. switch in the RAISE position) should be chosen.

k. Place the AFC-MANUAL switch on the control-power supply panel in the AFC position.

l. Check to see that the dehydrator pressure gage reads approximately 12 psi and that the dry air indicator is blue.

m. At the indicator, turn the RANGE SHIFT switch to the ON position and be sure that two range strobe lines appear. The two resulting range marks represent the upper and lower beams, approximately 500 meters apart.

52. Locating Targets
(fig. 29)

a. Press the AZIMUTH switch to CW or CCW to rotate the antenna and cover any 450-mill sector of expected target area. The scanner will sweep this 450-mil sector for targets which will be indicated on the B-scope.

b. Press the ELEVATION switch to RAISE or LOWER to position the reflector so that the elevation angle is 15 mils above the highest hill in the expected area. At this point, ground clutter should decrease to a minimum. (Use the telescope to determine the elevation angle for the top of the highest hill.)

c. As the antenna sweeps out two beams, two indications of the target will appear on the screen a short interval apart (A, fig. 30). Set the EXPANDED SWEEP DELAY switch so that the bright band on the B-scope incloses the approximate position of the target. (If the approximate position is previously known, it will be possible for the operator to have expanded the sweep before the target appears on the screen.) This is shown in B, figure 30. Turn the LOWER BEAM RANGE control on the computer to set the range strobe lines within the bright band. To expand the bright band over the entire area of the screen, turn the RANGE SELECTOR switch to 2500 M (C, fig. 30).

d. At the instant the first echo is seen on the expanded B-scope, press either of the two TIMER buttons to start the SECONDS clock and mark the target presentation with a grease pencil. When the second echo appears, press either TIMER button again to stop the clock and mark the second target presentation. The elapsed time between echoes appears on the clock.

53. Computing Weapon Position

a. Turn the LOWER BEAM RANGE control, on the computer, until the lower range strobe line intersects the first (lower beam) echo on the B-scope (A, fig. 31).

b. Turn the LOWER BEAM AZIMUTH control until the azimuth strobe line intersects the lower beam echo (A, fig. 31).

c. Place the detent switch in the DETENT RELEASE position.

d. Rotate the △ RANGE control until the upper range strobe line intersects the second (upper beam) echo on the B-scope (B, fig. 31).

e. Rotate the △ AZIMUTH control until the azimuth strobe line intersects the upper beam echo (B, fig. 31).

f. Rotate the control below the △ TIME counter until the time lapse between the two echoes appears on the counter.

g. Read the WEAPON LOCATION EASTING and NORTHING counters to obtain east and north map coordinates for location of weapon. Weapon range and azimuth positions are read on the RANGE and AZIMUTH counters.

h. Check the derived location of the weapon on a contour map. If the elevation at the weapon location is different from that of the radar site, set in the weapon HEIGHT counter the weapon-location elevation noted on the map.

i. Make certain that the DOUBTFUL SOLUTION indicator lamp is not on.

j. Read the final values on the WEAPON LOCATION EASTING and NORTHING counters to obtain the location of the weapon position.

k. Place the detent switch in the OFF position.

l. Reset the △ RANGE and △ AZIMUTH controls to their detent position.

m. Reset the weapon HEIGHT counter to the same value as the RADAR HEIGHT counter and returns △ TIME counter to zero.

n. On the indicator, press the RESET switch to return the SECONDS clock to zero.

o. The equipment is now ready for the next problem.

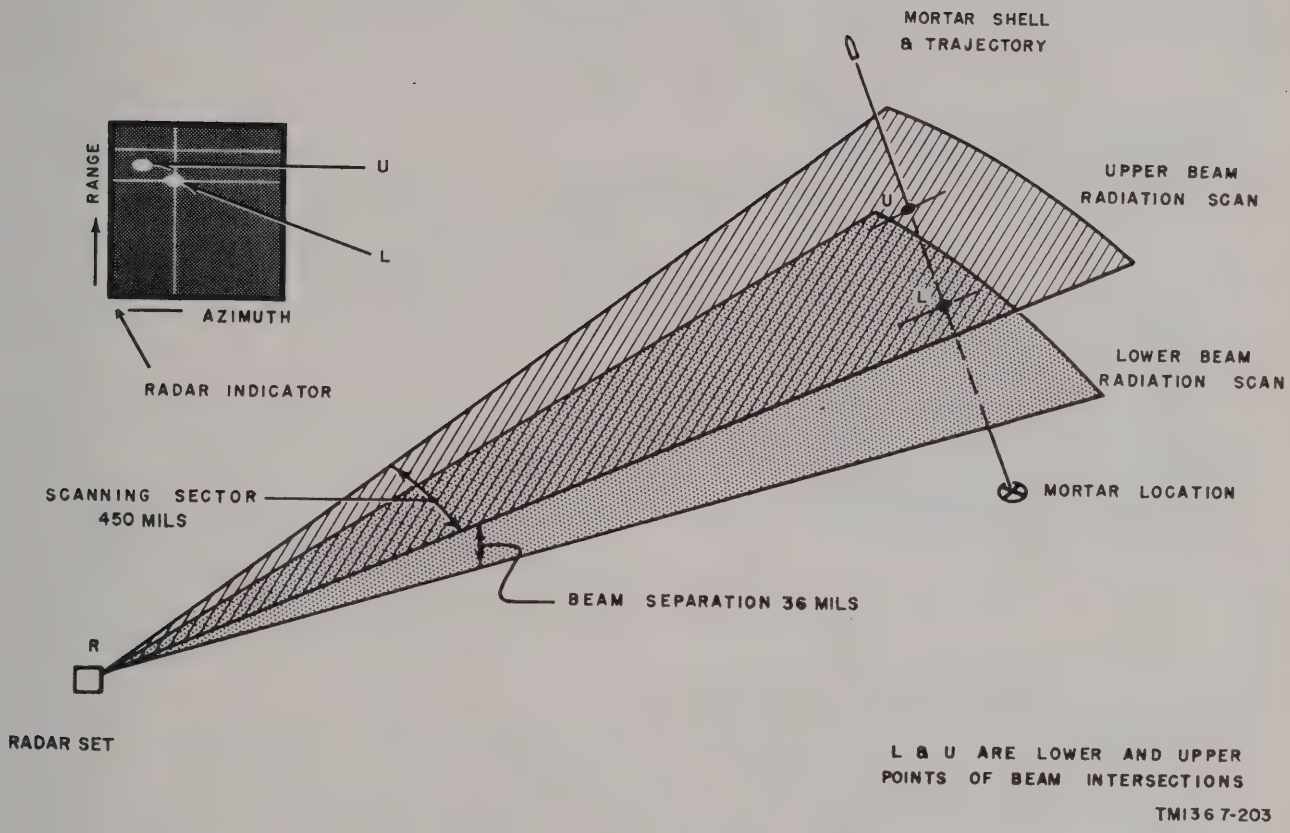

Figure 29. Radiation scanning pattern for weapon location.

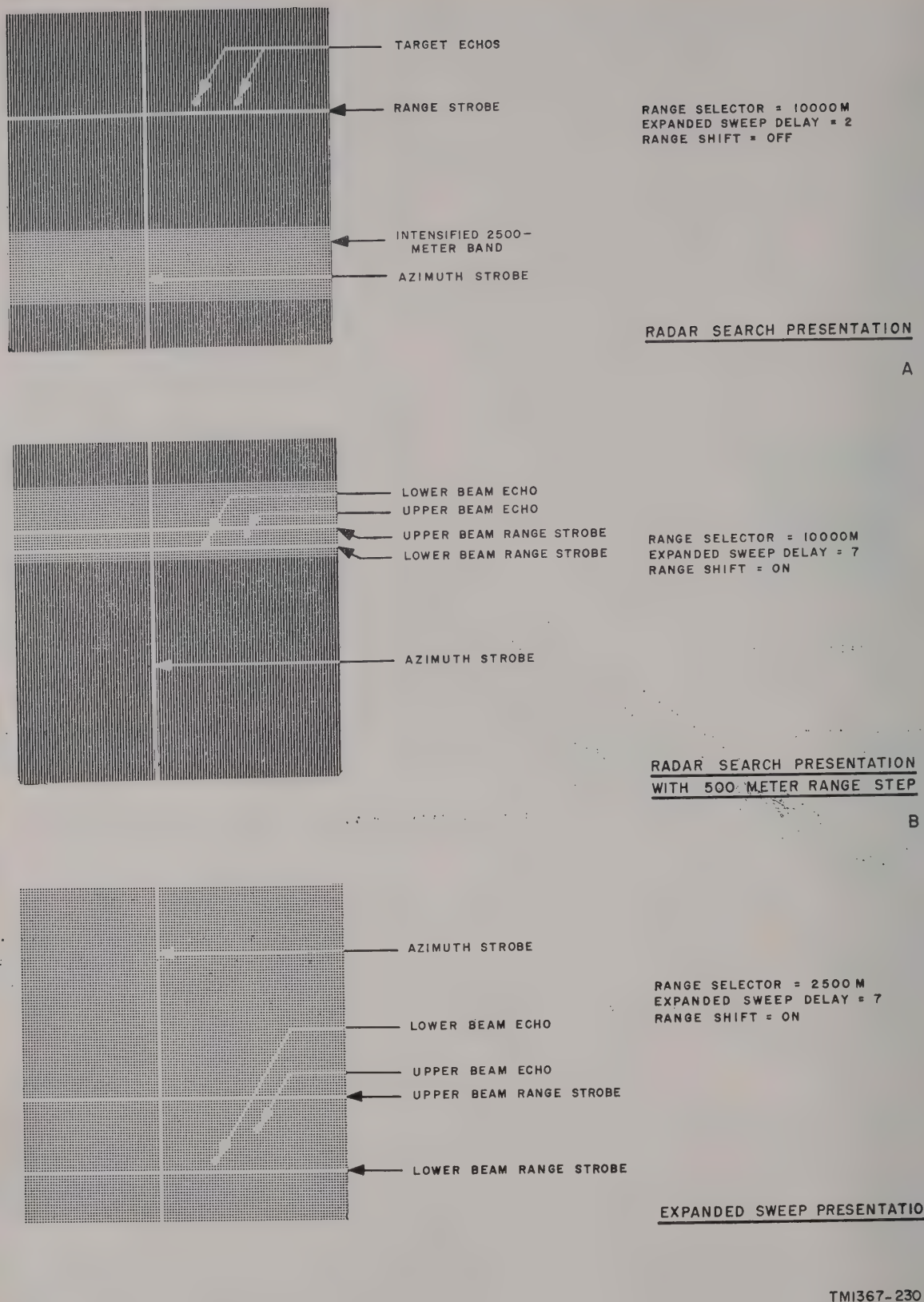

Figure 30. B-scope presentation of received signals.

54. Computing Impact Area

Radar Set AN/MPQ–4A may be used to compute the impact area of outgoing (friendly) mortar rounds. The observed presentation will be identical with the scope pattern in figure 29, except that the shell will be moving downward and the upper beam echo will appear on the B-scope first (fig. 32).

a. Rotate the LOWER BEAM RANGE control until the lower range strobe line intersects the second (lower beam) echo on the B-scope.

b. Rotate the LOWER BEAM AZIMUTH control until the azimuth strobe line intersects the lower beam echo.

c. Set the detent switch to DETENT RELEASE.

d. Rotate the △ RANGE control until the upper range strobe line intersects the first (upper beam) echo on the B-scope.

e. Rotate the △ AZIMUTH control until the azimuth strobe line intersects the upper beam echo.

f. Rotate the control below the △ TIME counter until the time lapse between the two echoes appears on the counter.

g. Read WEAPON LOCATION EASTING and NORTHING counters to obtain east and north map coordinates for location of impact area. Range and azimuth of impact area will be read on the RANGE and AZIMUTH counters.

h. Check the derived location of the impact area on a contour map. If the elevation of the impact area is different from that of the radar site, set the impact area elevation into the weapon HEIGHT counter.

i. Make sure that the DOUBTFUL SOLUTION indicator lamp is not lighted.

j. Read the final values on the WEAPON LOCATION EASTING and NORTHING counters for the location of the impact area.

k. Place the detent switch in the OFF position.

l. Reset the △ RANGE and △ AZIMUTH controls to their detent position.

m. Reset the weapon HEIGHT counter to the same value as the RADAR HEIGHT counter and return the △ TIME counter to zero.

n. On the indicator, press the RESET switch to return the SECONDS clock to zero.

o. The equipment is now ready for the next problem.

55. Beam Video Blanking

a. Video blanking is provided in the indicator to eliminate any difficulty in determining whether a target is in the upper or lower beam. Turn the BEAM VIDEO switch to LOWER. Only the lower beam video can be seen on the screen. When a target appears and the TIMER button is pressed, the video is switched from the lower beam to the upper beam. Therefore, the next target which appears on the scope will be an upper beam target and can be marked without confusion. When the TIMER button is pressed again to stop the timer, the video is once again switched to the lower beam.

b. When the BEAM VIDEO is set to UPPER, the upper beam video will appear on the B-scope. This presentation will remain until the clock is started, at which time the video is switched to the lower beam.

c. With the switch in the BOTH position, the video from both beams is displayed on the B-scope for normal operation.

56. Stopping Equipment

The equipment may be put in standby or nonradiating condition during short periods of enemy inactivity or as directed by existing authority.

a. Press the STOP button on the control-power supply panel (fig. 26). This removes the high voltage from the modulator circuit and the transmitter becomes inoperative, but ready for immediate use. The RADIATE indicator lamp goes out, while the READY indicator lamp remains on. The radar set is now in standby operation.

b. To stop the equipment, turn the MAIN POWER switch to the OFF position. The READY and MAIN POWER ON & INTLK CLOSED indicator lamps will go out.

c. Press the POWER UNIT switch to the STOP position. The POWER UNIT indicator lamp will go out.

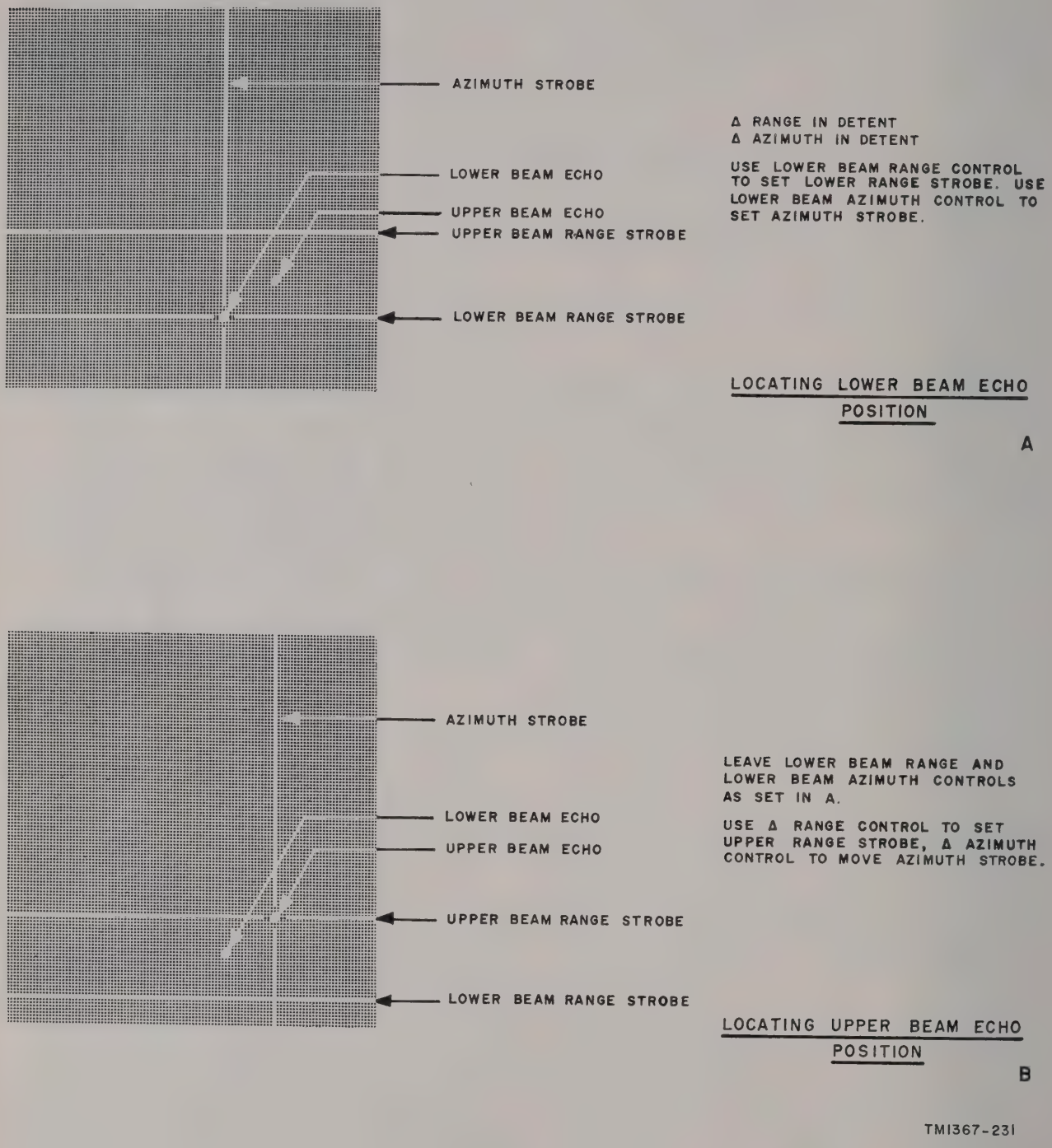

Figure 31. Use of strobe line on B-scope.

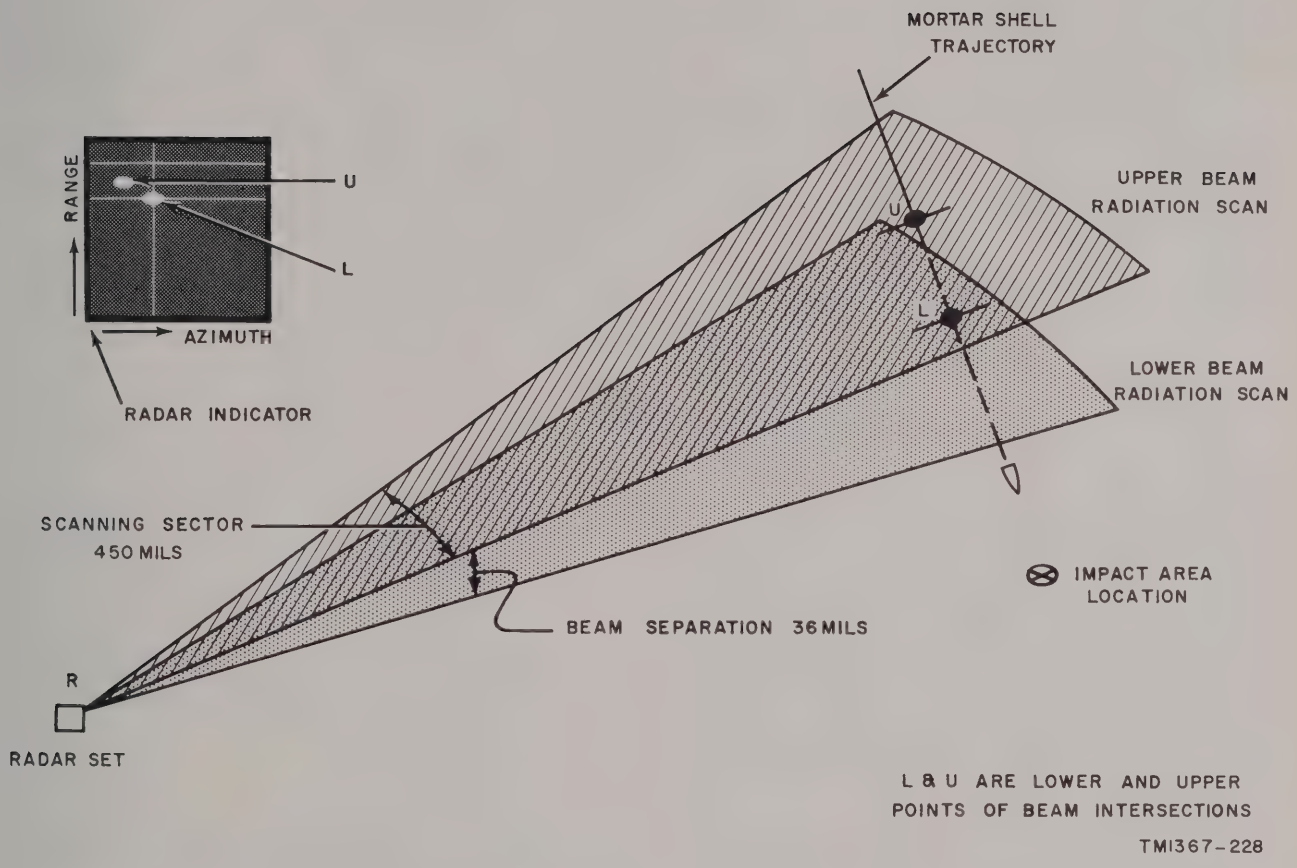

Figure 32. Radiation scanning pattern for impact area location.

CHAPTER 4
OPERATOR'S MAINTENANCE

Section I. GENERAL

57. Scope of Maintenance To Be Performed by Operator

a. Change fuses and lamps.

b. Tighten cables, terminals, and mechanical fasteners.

c. Clean air filters.

d. Make performance tests with echo box, B-scope, and test meters (which are located on equipment).

e. Perform preventive maintenance as outlined on DA Form 11–238.

f. Check proper operation of equipment.

g. Make operational adjustments.

58. Tools and Test Equipment Required

a. Tools.

Screwdriver TL–21; 3-inch long blade, $\frac{3}{16}$-inch wide tip

Screwdriver; 6-inch long blade, $\frac{9}{64}$-inch wide tip

Wrench; Spintite $\frac{5}{8}$-inch

Wrench; strap stock No. 6R56609

Sandpaper, #000

Cloth, textile; bleached and lintless

b. Test Equipment.

Tuned Cavity FR–111/MPQ–4A

Section II. MAINTENANCE

59. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when it is not in use) to keep it in good working order so that breakdowns and interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occuring.

60. General Preventive Maintenance Techniques

a. Use #000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, clean parts, except for electrical contacts, with a cloth or brush moistened with cleaning compound (Federal stock No. 7930–395–9542), and then wipe the parts dry with a cloth.

Warning: Cleaning Compound is flammable and its fumes are toxic. Do not use near a flame; provide adequate ventilation.

(2) Clean electrical contacts with a cloth moistened with Cleaning Compound, and then wipe them dry with a cloth.

61. Use of Maintenance Checklist for Signal Equipment

(fig. 33)

a. DA Form 11–238 is a preventive maintenance checklist to be used by the operator as directed by his commander.

b. Items not applicable to Radar Set AN/MPQ–4A are lined out on figure 33. References under ITEM in the illustration pertain to paragraph 62, which contains additional maintenance informaion pertinent to the particular item.

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
26. INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	✓
27. CHECK FOR NORMAL OPERATION. PAR. 72f	✓
28. BEFORE SHIPPING OR STORING REMOVE BATTERIES PAR. 72b	✓

IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING THE INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

ITEM-5. HINGE FOR LOCKING THE AIR VENT PANEL OF THE CONTROL-INDICATOR CABINET IN THE OPEN POSITION IS BROKEN. CONDITION REPORTED TO 2D ECHELON FOR REPAIR. H.R.

ITEM-5. CONDITION REPORTED TO HIGHER ECHELON FOR REPAIR. (WELDING REQUIRED). J.E.

FOLD

MAINTENANCE CHECK LIST FOR SIGNAL EQUIPMENT
SOUND EQUIPMENT, RADIO, DIRECTION FINDING
RADAR, CARRIER, RADIOSONDE AND TELEVISION
(AR 750-625)

EQUIPMENT NOMENCLATURE: RADAR SET AN/MPQ-4A

EQUIPMENT SERIAL NUMBER: 15

INSTRUCTIONS

This form may be used for a period of one month by using the correct dates and weeks of the month. It is to be used as a Preventive Maintenance check list for Signal equipment in actual use, or for a check on equipment prior to issue.

1. For detailed Preventive Maintenance instructions see;
   a. The Technical Manual *(in TM 11 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   b. The Supply Bulletin *(SB 11-100 series)* for the equipment. *(See DA Pamphlet Number 310-4)*
   c. The Department of the Army Lubrication Order. *(See DA Pamphlet Number 310-4)*

2. The following action will be taken by either the Communications Officer/ Chief for 1st echelon, or the Inspector for higher echelon:
   a. Enter Equipment Nomenclature and Serial Number.
   b. Strike out items that do not apply to the equipment.

3. Operator/Inspector will enter in the columns entitled CONDITION, on the proper line, a notation regarding the condition, using symbols specified under LEGEND.

4. After operator completes each daily inspection he will initial over the appropriate dates under "Daily Condition for Month", then return form to his supervisor.

TYPE OF INSPECTION

OPERATOR	2/3 ECHELON	DATE	SIGNATURE
✓		MARCH 7, '58	SP/3 Harry Roberts
	✓	MARCH 10, '58	SP/2 John Erle

4

DA FORM 1 MAY 57 11-238

REPLACES DA FORMS 11-238, 1 NOV 55; 11-239, 11-244, 11-245, 11-248, 11-249, 11-250, AND 11-251; WHICH ARE OBSOLETE.

TM1367-252 ①

Figure 33. DA Form 11–238.

LEGEND for marking conditions:
Satisfactory, ✓
Adjustment, Repair or Replacement required, X
Defect corrected, (X)

DAILY CONDITION FOR MONTH OF MARCH 1958

NO.	DAILY ITEM	1 OD 17	2 OD 18	3 HR 19	4 HR 20	5 HR 21	6 HR 22	7 HR 23	8 OD 24	9 OD 25	10 HR 26	11 HR 27	12 28	13 29	14 30	15 31	16	2D 3D ECHELON
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*Transmitter, receiver, ~~carrying cases~~, wire, cables, ~~microphones~~, tubes, spare parts, technical manuals*). PAR. 62a	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓
2	CLEAN DIRT AND MOISTURE FROM ANTENNA, ~~MICROPHONES, HEADSETS, KEYS~~, JACKS, PLUGS, COMPONENT PANELS PAR. 62c	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓
3	INSPECT CONTROLS FOR NORMAL OPERATION ~~TAP CONTROLS LIGHTLY FOR EVIDENCE OF CUT OUT FROM LOOSE CONTACTS~~. PAR. 62d	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓
4.	CHECK FOR NORMAL OPERATION OF EQUIPMENT BE ALERT FOR UNUSUAL OPERATION OR CONDITION PAR. 62e	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓						✓

WEEKLY	CONDITION EACH WEEK 1ST	2D	3D	4TH	5TH	2D 3D ECH
5 CLEAN AND TIGHTEN EXTERIORS OF CASES, RACKS MOUNTS ~~TRANSMISSION LINES~~. PAR. 72g	X					X
6 INSPECT CASES MOUNTS, ANTENNA ~~TOWERS~~ AND EXPOSED METAL SURFACES FOR RUST CORROSION	✓					✓
7 INSPECT CORDS, CABLE WIRE SHOCK MOUNTS FOR CUTS, KINKS BREAKS, FRAYING, UNDUE STRAIN	✓					✓
8 CHECK ANTENNA ~~GUY WIRES~~ FOR ~~PROPER TENSION OR~~ DAMAGE	✓					✓
9. INSPECT CANVAS ~~AND LEATHER~~ ITEMS FOR MILDEW TEARS, FRAYING	✓					✓
10 INSPECT ACCESSIBLE ITEMS FOR LOOSENESS: SWITCHES, KNOBS, JACKS, CONNECTORS RELAYS TRANSFORMERS, MOTORS PILOT LIGHTS, BLOWERS, ETC	✓					✓
11 CLEAN AND/OR INSPECT AIR FILTERS, ~~BRASS~~ NAME PLATES, DIAL AND METER WINDOWS. PAR. 72i	✓					✓
12 INSPECT STORAGE BATTERIES FOR DIRT LOOSE TERMINALS, SPECIFIC GRAVITY DAMAGED CASES. ~~INSPECT DRY BATTERIES FOR LEAKAGE~~. PAR. 72h	✓					✓

ADDITIONAL ITEMS FOR 2D AND 3D ECHELON INSPECTIONS	CONDITION
13 INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER-PROOFING TEARS, FRAYING.	
14. CHECK TERMINAL BOX COVERS FOR CRACKS, DIRT, LEAKS, DAMAGED GASKETS, GREASE	

ADDITIONAL ITEMS FOR 2D AND 3D EC HELON INSPECTIONS	CONDITION
15 INSPECT SEATING OF READILY ACCESSIBLE PLUCK-OUT ITEMS: TUBES, LAMPS, FUSES, CRYSTALS, CONNECTORS, ~~VIBRATORS, PLUG-IN COILS~~. PAR. 72d	✓
16 INSPECT RELAYS AND CIRCUIT BREAKERS FOR LOOSE MOUNTINGS, ~~BAD CONTACTS, MIS-ALINEMENT OF CONTACTS AND SPRINGS, PROPER SPRING TENSION~~.	✓
17 INSPECT VARIABLE CAPACITORS FOR DIRT, MIS-ALINEMENT OF PLATES, LOOSE MOUNTINGS, MOISTURE	✓
18. INSPECT RESISTORS, BUSHINGS AND INSULATORS FOR CRACKS, CHIPPING, BLISTERING, MOISTURE, DISCOLORATION.	✓
19. CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE.	✓
20. INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	✓
21. INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR DIRT, CORROSION, LOOSE CONTACTS.	✓
22 INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS AND RHEOSTATS FOR OVERHEATING AND OIL LEAKAGE.	✓
23. INSPECT GENERATORS, ~~AMPLIDYNES, DYNAMOTORS~~ FOR BRUSH WEAR, SPRING TENSION, ARCING AND FITTING OF COMMUTATOR.	✓
24. INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	✓
25. INSPECT WATERPROOF GASKETS FOR LEAKS, WORN OR LOOSE PARTS. PAR. 62i	✓

CONTINUED ON PAGE 4

2 3

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Figure 33—Continued.

62. Operator's Preventive Maintenance

The following preventive maintenance operations should be performed at the intervals indicated: *a* through *e*, daily; *f* through *j*, weekly.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will become damaged or broken.

a. Check the completeness and general condition of all items stowed on the power unit trailer. These include carrying cases, cables, spare parts, accessories, and technical manuals. Accessories are listed in paragraph 15 and running spares are listed in paragraph 5*b*.

b. Check for normal operation (par. 25). Be sure the spirit level on the antenna is still leveled (par. 29).

c. Remove dirt and moisture from the jacks and plugs on the various components. Remove dirt and debris from the radome window on the scanner output feed horns. Remove dirt from the joint between the upper rotating and lower stationary portions of the pedestal.

d. Inspect all controls on the radar set for binding, scraping, excessive looseness, misalignment, and positive action.

e. Check for normal operation (par. 65). Observe the scanner assembly for any marked increase in vibration. This can be caused by an unbalanced scanner rotor, and will damage the assembly if operation is continued. Note any audible changes in the scanner during operation which can be caused by interference of moving parts in the rotor.

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation.

f. Clean and tighten connections. Be sure the blower panels fit snugly when closed. Tighten the bolts that secure the cabinets to the trailer frame.

g. Inspect the storage battery in the power unit for dirt, loose terminals, electrolyte level, and damaged case.

h. Clean name plates, meter windows, and counter windows. Clean all air filters by immersing them in a shallow container filled with cleaning compound (par. 68).

i. Check the terminal box cover on the power unit for cracks, leaks, damaged gaskets, dirt, and grease.

63. Visual Inspection

Failure of this equipment to operate properly will usually be caused by one or more of the following faults:

a. Improperly connected power or ground cables (par. 35).

b. Worn, broken, or disconnected cords or plugs.

c. Burned-out fuses (par. 66).

d. Relay contacts burned because of overload.

e. Wires broken because of excessive vibration.

f. Doors or drawers not completely closed.

g. Blower vents not open (par. 50*f*).

h. Insufficient air pressure in dehydrator.

i. Physical deformity of the reflector and scanner.

j. Reflector not securely locked.

64. Use of Operator's Checklist

a. General. The checklist given in paragraph 65 will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications of correct operation, and the corrective measures that may be taken by the operator.

b. Action or Condition. For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check normal indications given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible or audible signs that the operator should perceive when he checks the items. If these signs are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without assistance from the unit repairman. A reference in the table to paragraph 77, indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not give results, troubleshooting is necessary. If the tactical situation calls for it, and the system is not completely inoperative, the operator must maintain the radar set in operation as long as possible.

65. Operator's Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Cables	Check connections (par. 35).	No disconnected cables	Tighten or connect.
	2	Drawers and front panels.	Must be closed	System operates and MAIN POWER ON & INTLK CLOSED lamp goes on when set is energized.	Close drawers and doors tightly.
	3	Blower panels	Must be open	System operates and MAIN POWER ON & INTLK CLOSED lamp goes on when set is energized.	Open panels.
START	4	POWER UNIT switch (fig. 26).	Operate to start	POWER UNIT lamp goes on	Replace lamp. Check item 1. Operate switch to STOP position. Check at the power unit to see that the ON-OFF switches are ON and the IGNITION MANUAL START-REMOTE START switch is in REMOTE START position. See TM 5–5264.
	5	MAIN POWER switch (fig. 26).	Turn to ON	MAIN POWER ON & INTLK CLOSED lamp lights. 120 V AC blown fuse lamps do not go on. READY lamp lights after 5-minute period.	Replace MAIN POWER ON & INTLK CLOSED and READY lamps. Check items 2 and 3. Replace 5 AMP fuse (fig. 27).
EQUIPMENT PERFORMANCE	6	Blowers		Two blowers in receiver-transmitter and one blower in control-indicator operate.	Check 120 V AC blown fuse indicator lamps (fig. 27).
	7	ELEVATION switch (fig. 27).	Operate first in RAISE then in LOWER position.	Reflector first tilts up, then tilts down.	Check item 1. Check 120 V AC blown fuse indicator lamps (fig. 27).
	8	AZIMUTH switch (fig. 27).	Operate first in CW, then in CCW position.	Antenna should move in azimuth correspondingly.	Check item 1. Check stowlock. Check 120 V AC blown fuse indicator lamps (fig. 27). Check position of azimuth handwheel.
	9	Dehydrator	Hinge up air input cover on front panel.	Pressure gage reads approximately 12 psi.	Check hose connection to waveguide.
				Dry air indicator shows blue	Higher echelon repair required.
	10	START switch (fig. 26).	Press START button	RADIATE lamp lights	Replace RADIATE lamp. Close transmitter door tightly. Check dehydrator pressure (item 9).
	11	MAGNETRON POWER control.	Adjust for normal magnetron current.	20 ma	Higher echelon repair required.
	12	TEST METER SELECTOR switch (fig. 27).	Rotate switch to AFC XTAL CUR.	2.5 ±.5	Higher echelon repair required.

EQUIPMENT PERFORMANCE

Item No.	Item	Action or condition	Normal indications	Corrective measures
13	TEST METER SELECTOR switch (fig. 23).	Rotate switch to XTAL 1.	2.5 ±.5	Same as 12.
		Rotate switch to XTAL 2.	2.5 ±.5	Same as 12.
14	L. O. RAISE LOWER switch (fig. 27).	Set A.F.C. MANUAL switch on control-monitor to A.F.C. On control-power supply, set AFC - MANUAL switch to MANUAL. Operate L. O. RAISE LOWER switch up or down as required.	Maximum video signal on B-scope.	Same as 12.
		Set control-power supply AFC - MANUAL switch to AFC.	No change in video signal on B-scope.	Same as 12.
15	Indicator B-scope (fig. 25).	Observe screen with RANGE SELECTOR switch in 10000 M position.	Screen should have visible raster.	Adjust INTENSITY control (fig. 25) for desired raster brightness. Adjust FOCUS control for sharpest definition.
16	EXPANDED SWEEP DELAY switch (fig. 25).	Switch from 0 through 10 consecutively.	Intensified portion of sweep should move from bottom to top of screen in successive steps of 1,000 meters.	Higher echelon repair required
17	RANGE SELECTOR switch (fig. 25).	Switch to 2500 M position.	Full vertical sweep on screen with intensified band 2,500 meters wide across screen.	Same as 16.
18	VIDEO control (fig. 25).	Turn knob fully clockwise.	Increased signal and noise intensity on scope screen.	Same as 16.
19	IF GAIN control (fig. 25).	Turn knob clockwise or counterclockwise.	Signal and noise intensity increases with clockwise rotation, decreases with counterclockwise rotation. Set to threshold of noise with VIDEO control fully cw.	Same as 16.
20	Range controls (fig. 25).	TURN MARKERS ON switch to ON.	Markers occur at 2,000, 4,000, 6,000, 8,000, and 10,000 meters if system is radiating, afc is properly locked on, and receiver gain is sufficient.	Same as 16.
		Turn RANGE MARK control clockwise or counterclockwise.	Adjust intensity of range marker as desired.	Same as 16.
21	AZIMUTH MARK control (fig. 25).	Turn knob clockwise or counterclockwise.	Adjusts intensity of azimuth strobe line as desired.	Same as 16.
22	RANGE SHIFT switch (fig. 25).	Switch to ON	Displaces upper beam raster 500 meters above lower beam raster.	Same as 16.
23	BEAM VIDEO switch (fig. 25).	Switch to BOTH position. Operate ELEVATION switch until a convenient lower beam fixed target appears on crt.	Target appears on screen	Same as 16.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
			Switch BEAM VIDEO switch to UPPER position.	Target disappears from screen	Same as 16.
			Press ELEVATION switch to LOWER until upper beam video is obtained on crt.	Target reappears on screen	Same as 16.
			Switch BEAM VIDEO to LOWER position.	Target disappears from screen	Same as 16.
EQUIPMENT PERFORMANCE	24	TIMER switches (fig. 25).	With BEAM VIDEO switch in BOTH position, operate ELEVATION switch until a convenient lower beam fixed target appears on crt. Switch BEAM VIDEO to LOWER and press either TIMER button.	Clock starts and target disappears from screen.	Same as 16.
			Press ELEVATION switch to LOWER until the target reappears as upper beam video. Press either TIMER button.	Clock stops and target disappears from screen.	Same as 16.
	25	RESET switch (fig. 25).	Press to reset clock to zero.	Clock hands will return to zero	Same as 16.
	26	PLOTTER DIMMER control (fig. 25).	Turn clockwise or counterclockwise to vary illumination of plotter scale.	Illumination will vary with rotation of control.	Replace pilot lamps (par. 67).
	27	PANEL DIMMER control (fig. 25).	Turn clockwise or counterclockwise to vary illumination of front panel.	Illumination will vary with rotation of control.	Replace pilot lamps (par. 67).
STOP	28	STOP switch (fig. 26).	Press STOP button	RADIATE lamp goes out. Transmitter inoperative.	Same as 16.
	29	MAIN POWER switch (fig. 26).	Switch to OFF	READY and MAIN POWER ON & INTLK CLOSED lamps go out. Radar set inoperative.	Same as 16.
	30	POWER UNIT switch (fig. 26).	Switch to STOP	POWER UNIT lamp goes out.	Same as 16.

66. Fuse Replacement

a. Replacing Fuses. The blown fuse indicator lamps on Control-Power Supply C–2014/MPQ–4A (fig. 27) and Power Supply PP–1588/MPQ–4A (fig. 24) will light when fuses are blown. All the fuses located on the front panels are the cartridge type. The control-power supply contains four fuses (F652, F654, F656, and F657) on the rear of the panel (fig. 34). The panel is hinged at the bottom and may be swung down to reach the fuses. A convenience outlet fuse (F1001) is mounted on the right-side cabinet wall of the control-indicator group (fig. 72). Pull out the indicator drawer to replace this fuse. Be sure to replace the blown fuse with a correctly rated one. Turn the MAIN POWER switch to OFF before replacing any fuse.

b. Fuse Complement.

Panel marking	Fuse rating	Function
Control-power supply (fig. 30 and 50)		
10 AMP	250 V, 10 amp	Fuse for 120-volt ac supply, line L1 to control-indicator group.
F652	125 V, 20 amp	Fuse for 120-volt ac supply, line L1A, to computer.
10 AMP	250 V, 10 amp	Fuse for 120-volt ac supply line L2, to pedestal.
F654	125 V, 20 amp	Fuse for 120-volt ac supply, line L2A, to computer.
20 AMP	125 V, 20 amp	Fuse for 120-volt ac supply, line L3, to magnetron.
F656	125 V, 20 amp	Fuse for 120-volt ac supply line L3A, to computer.
F657	1,000 V, .250 amp	Fuse for +440-volt dc supply to indicator.
.5 AMP	250 V, .50 amp	Fuse for +220-volt dc supply to indicator.
.25 AMP	250 V, .250 amp	Fuse for +220-volt dc supply to computer.
.125 AMP	250 V, .125 amp	Fuse for −220-volt dc supply to indicator.
5 AMP	250 V, 5 amp	Fuse for +27-volt dc supply.
Control-indicator group cabinet (fig. 72)		
F1001	250 V, 10 amp	Fuse for 120-volt ac convenience outlet and shelter blowers and lights.
Low-voltage power supply (fig. 25)		
.125 AMP	250 V, .125 amp	Fuse for +300-volt dc supply.
.250 AMP	250 V, .250 amp	Fuse for +150-volt dc supply.
.062 AMP	250 V, .062 amp	Fuse for −300-volt dc supply.

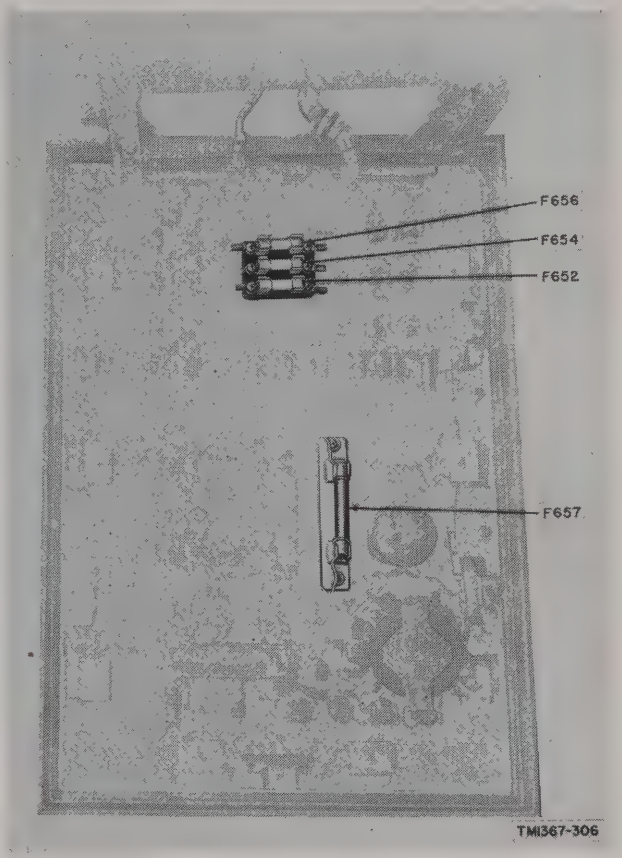


Figure 34. Control-power supply panel, rear view.

67. Lamp Replacement

The indicator and illumination lamps for the radar set are listed in the tables below. All lamps have bayonet-type bases.

a. Indicator Lamp Replacement. There are eight illumination lamps and one indicator lamp used on the indicator. The four reflection plotter lamps are found directly behind the plotter cover (fig. 35). Remove the eight Phillips-head screws that secure the cover to the panel and remove the cover to replace these lamps. To reach the timer illumination

lamps (fig. 35), loosen the two Phillips-head screws from the timer hood and remove the hood. One illumination lamp is located behind the RANGE SELECTOR name plate. Pull open the draw, loosen the pawl fasteners on the top left panel, and swing the panel up (fig. 36). To remove the lamp, remove the Phillips-head screw that secures the lamp holder in place. Another illumination lamp is found behind the EXPANDED SWEEP DELAY nameplate. Open the drawer, loosen the pawl fasteners on the bottom left panel, and swing the panel down (fig. 37). To remove the lamp, remove the Phillips-head screw that secures the lamp holder in place. The SET DETENT indicator lamp on the front panel (fig. 35) is replaced by unscrewing the protective cap.

b. Indicator Lamp Complement (figs 35 and 37).

Symbol	Lamp rating	Function
I 101	6.3 v, .2 amp	Illuminates the reflection plotter.
I 102	6.3 v, .2 amp	Illuminates the reflection plotter.
I 103	6.3 v, .2 amp	Illuminates the reflection plotter.
I 104	6.3 v, .2 amp	Illuminates the reflection plotter.
I 105	6.3 v, .2 amp	Illuminates the timer.
I 106	6.3 v, .2 amp	Illuminates the timer.
I 107	6.3 v, .2 amp	Illuminates the RANGE SELECTOR name plate.
I 108	6.3 v, .2 amp	Illuminates the EXPANDED SWEEP DELAY nameplate.
I 109	6.3 v, .2 amp	Indicates the computer Δ RANGE and Δ AZIMUTH controls are not in detent.

c. Control-Power Supply Lamp Replacement. The indicator lamps for the control-power supply are found on the front panel (fig. 27). Unscrew the protective caps to replace the lamps. All six 120 V AC blown fuse indicator lamps are type NE51.

d. Control-Power Supply Lamp Complement. All six 120 V AC blown fuse indicator lamps use type NE51 bulbs.

Panel marking	Lamp rating	Function
440 V DC	NE51	Indicates fuse F657 is blown (fig. 34).
IND	NE51	Indicates .5 amp fuse is blown.
COM-PUTER IND	NE51	Indicates .25 amp fuse is blown.
POWER UNIT RADIATE	NE51	Indicates .125 amp fuse is blown.
READY	6–8 v, .15 amp	Indicates power unit has started.
+27 V DC	6–8 v, .15 amp	Indicates transmitter is operating.
MAIN POWER ON & INTLK CLOSED	6–8 v, .15 amp	Indicates high voltage may be applied.
		Indicates 5 amp fuse is blown.
		Indicates ac is being applied to control-indicator group.

e. Computer Lamp Replacement. The three indicator lamps for the computer are found on the front panel (fig. 28). Unscrew the protective caps to reach the lamps. Four nameplate illumination lamps are attached to the rear of the applicable name plates (*f* below and fig. 21). To replace a nameplate lamp, remove the four Phillips-head screws and pull out the nameplate and attached lamp. The counter illumination lamps are mounted at the rear of the panel (figs. 20 and 38) and are accessible with the computer drawer pulled out. Slip the lamp holder from the mounting bracket before attempting to remove the lamp.

f. Computer Lamp Complement.

Panel marking	Symbol	Lamp rating	Function
Δ TIME	I 801	6–8 v, .25 amp	Illuminates the Δ TIME counter.
HEIGHT	I 806	6–8 v, .25 amp	Illuminates the HEIGHT counter.
WEAPON LOCATION	I 816(2)	6–8 v, .25 amp	Illuminates the WEAPON LOCATION EASTING and NORTHING counters.
LOWER BEAM ELEVATION	I 821	6–8 v, .25 amp	Illuminates the LOWER BEAM ELEVATION counter.
RANGE	I 831	6–8 v, .25 amp	Illuminates the RANGE counter.
AZIMUTH	I 841	6–8 v, .25 amp	Illuminates the AZIMUTH counter.
SET DETENT	I 851	6–8 v, .25 amp	Indicates Δ RANGE and Δ AZIMUTH controls are not in detent.

Panel marking	Symbol	Lamp rating	Function
DOUBTFUL SOLUTION	I 852	6–8 v, .25 amp	Indicates problem exceeds design limits of computer.
Δ AZIMUTH	I 859	6–8 v, .25 amp	Illuminates the Δ AZIMUTH name plate.
LOWER BEAM AZIMUTH	I 860	6–8 v, .25 amp	Illuminates the LOWER BEAM AZIMUTH nameplate.
Δ RANGE	I 861	6–8 v, .25 amp	Illuminates the Δ RANGE nameplate.
LOWER BEAM RANGE	I 862	6–8 v, .25 amp	Illuminates the LOWER BEAM RANGE nameplate.
AZIMUTH ORIENT	I 863	6–8 v, .25 amp	Indicates LOWER BEAM AZIMUTH control is in detent.

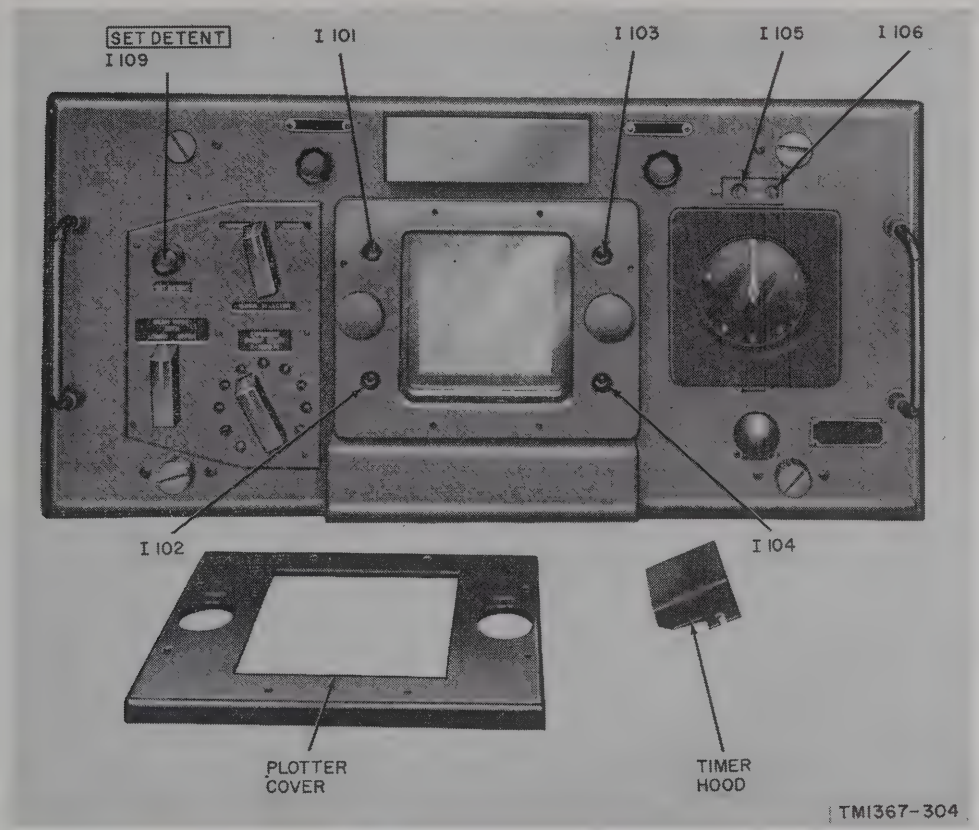


Figure 35. Indicator, front view, showing illumination lamps uncovered.

g. Electrical Equipment Shelter Lamp Replacement. The two overhead illumination lamps in the shelter are I 1001 and I 1002. They are located in the blower case covers and are rated at 120 volts, 10 watts.

h. Low Voltage Power Supply Lamp Replacement. The indicator lamps for this assembly are found on the front panel (fig. 24) and are protected by removable caps. All three blown fuse indicator lamps are type NE51 bulbs.

i. Antenna Group Lamp Replacement.

(1) *Azimuth counter illumination lamp I 3001* (A, fig. 39).

(*a*) Remove the six cap screws that secure the azimuth counter assembly to a bracket on the trailer.

(*b*) Remove the roundhead screws that secure the rear cover on the azimuth counter and remove the cover plate. This cover plate carries the clutch detent linkage.

(*c*) Remove lamp I 3001 from its socket inside the housing and insert the new lamp. This is a type 44, 6.3-volt, .25-ampere lamp.

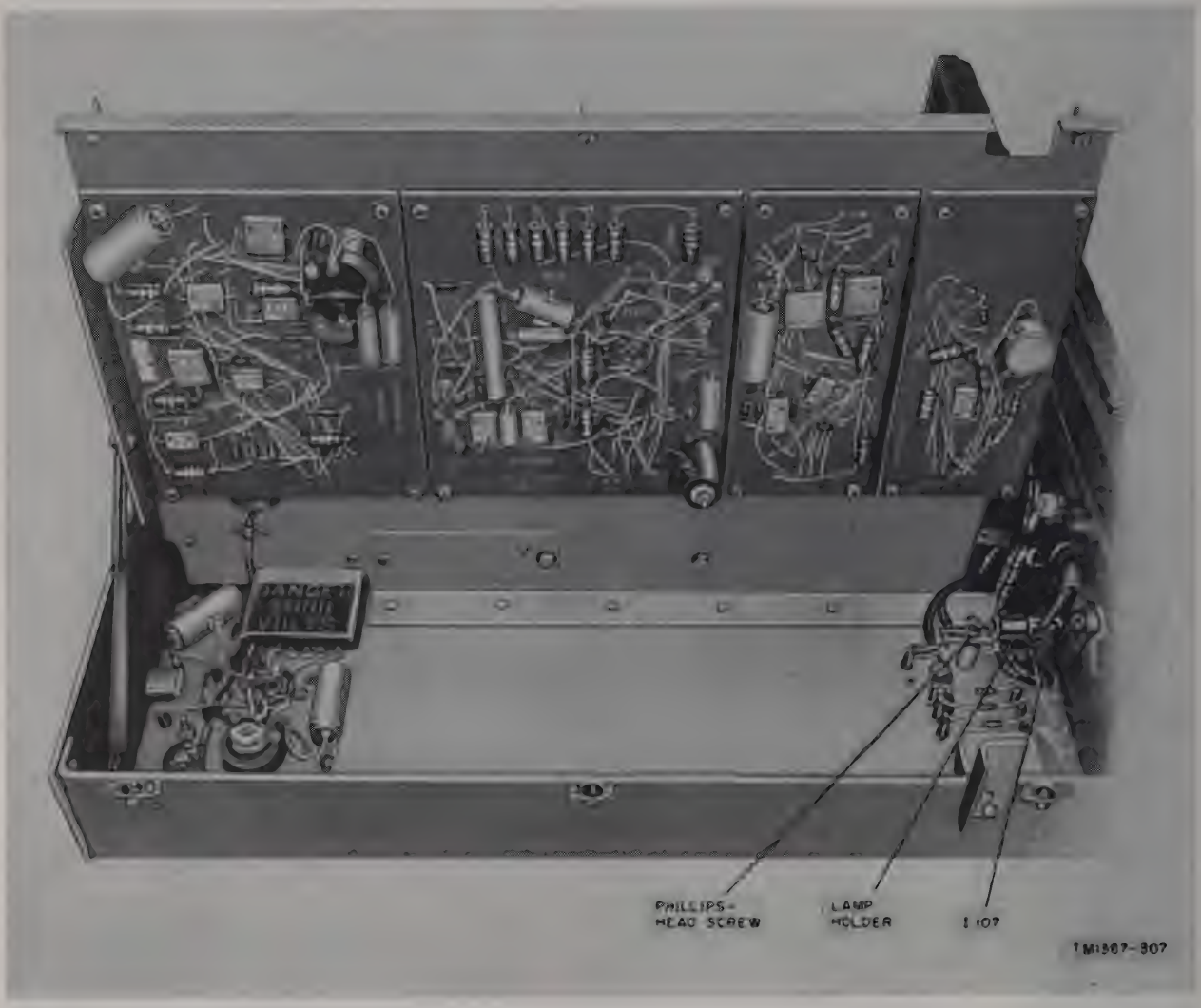


Figure 36. Indicator, partial view, showing top left panel swung up.

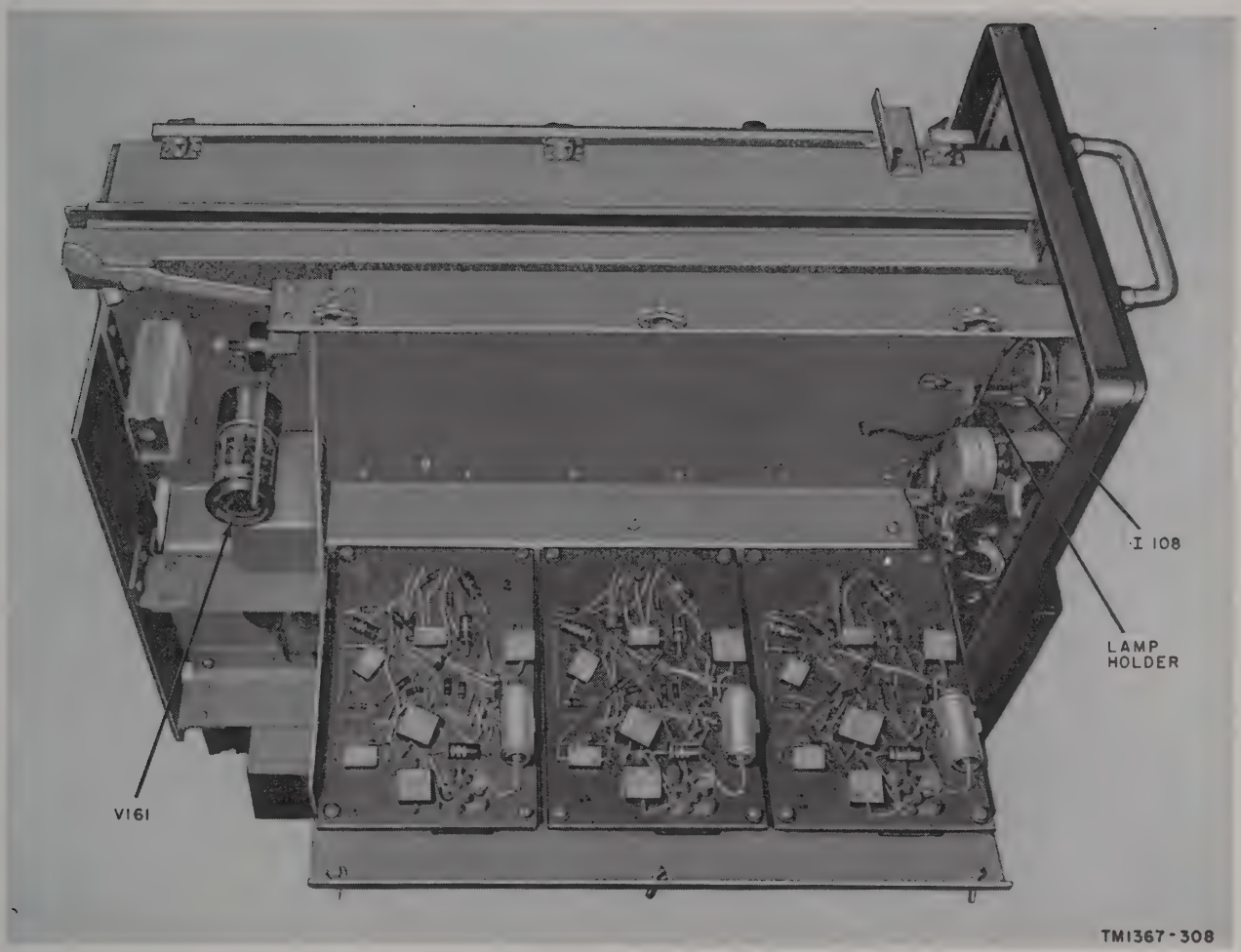


Figure 37. Indicator, partial view, showing bottom left panel swung down.

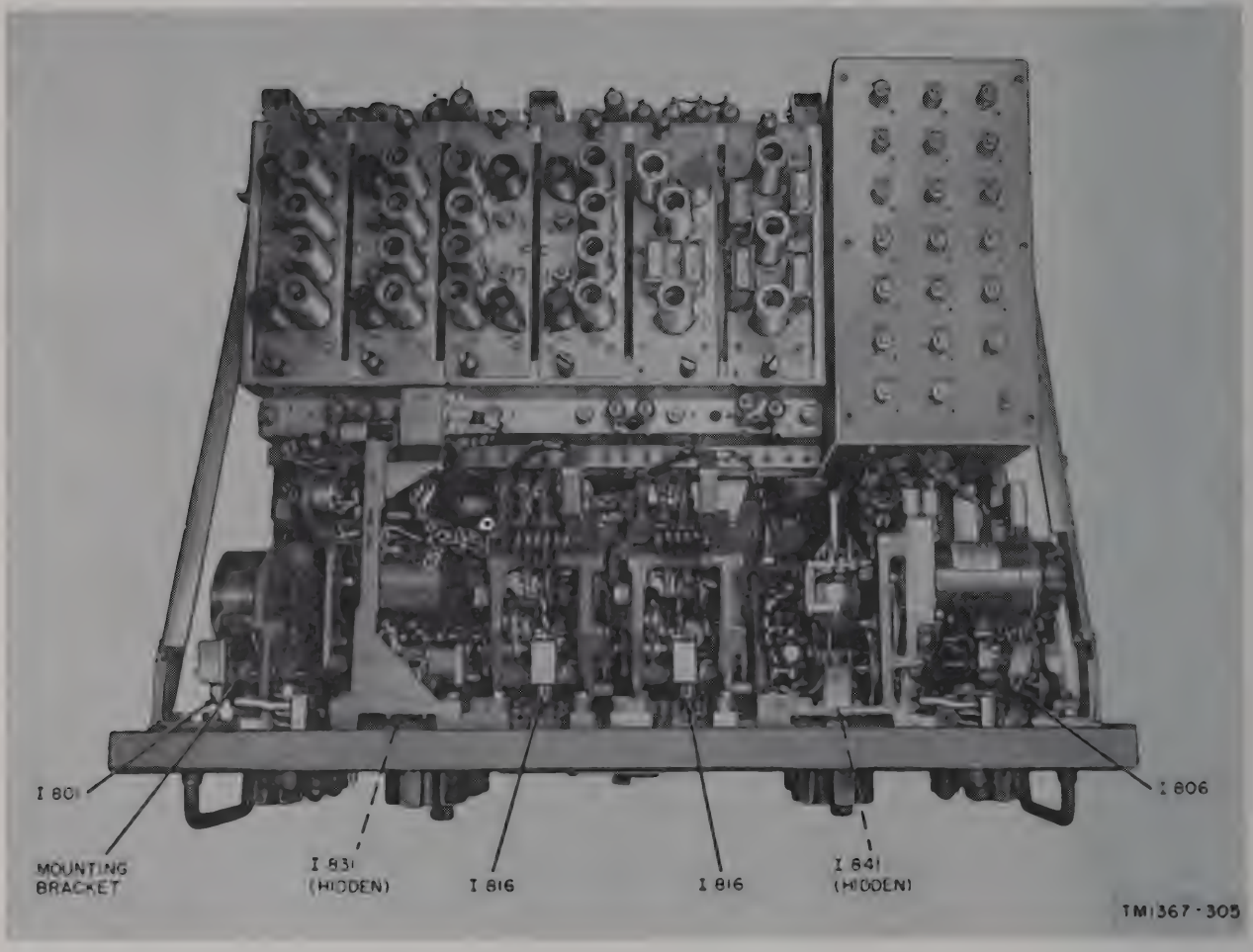


Figure 38. Computer, top view, showing counter illumination lamps.

(*d*) Replace the rear cover. Be sure to engage the yoke arms to their grooves in the clutch mechanism as the cover is put in place.

(*e*) Secure the cover to the housing with the roundhead screws.

(*f*) Secure the counter to the trailer bracket with the six cap screws.

(2) *Elevation counter illumination lamp I 3003* (B, fig. 39).

(*a*) Remove the 14 hexagonal head bolts that secure the front cover on the elevation synchro assembly and remove the cover.

(*b*) Remove the lamp shield at the side of the counter inside the assembly by removing the two screws. Lay the shield aside.

(*c*) Loosen the screw that secures the lamp socket to the counter and swing out the socket.

(*d*) Replace the lamp I 3003. This is a type 44, 6.3-volt, .25-ampere lamp.

(*e*) Secure the socket in its original position by tightening the screw.

(*f*) Secure the lamp shield in place with the two screws.

(*g*) Replace the front cover on the synchro assembly; make sure that the gasket is properly seated in its groove. Secure cover with the 14 hexagonal head bolts.

(3) *Level illumination lamp I 3002* (C, fig. 39).

Caution: Do not turn the leveling screws in the spirit level assembly. These are factory adjustments.

(*a*) Remove the eight screws that secure the bottom plate on the spirit level assembly. Lay the plate aside.

(*b*) Remove lamp I 3002 from its socket inside the housing and insert the new lamp. This is a type 44, 6.3 volts, .25 ampere lamp.

(*c*) Secure the bottom plate to the assembly with the eight screws.

(4) *Telescope reticle illumination lamp I 3201* (D, fig. 39).

(*a*) Slide the illumination housing off the telescope.

(*b*) Unscrew the square lamp housing from the lamp socket.

(*c*) Replace I 3201. This is a type 325, 3 volts, .19 ampere lamp.

(*d*) Screw the lamp housing back on the socket.

(*e*) Slide the illumination housing into place on the telescope.

68. Air Filter Cleaning and Replacement

Oil-filled mesh-type air filters are used in the radar set, and they may be cleaned when necessary. The procedure used to clean the filters is outlined in *a* below. Removal and replacement of the filters is covered in *b* through *e* below.

a. Cleaning Air Filters.

(1) Immerse the filter in a shallow container filled with Cleaning Compound.

(2) Agitate the filter to remove all dirt.

(3) Shake excess solvent from the filter and allow the filter to dry thoroughly.

(4) Dip the filter into lubricating oil, general purpose (2190) SAE 30 motor oil, or equivalent.

(5) Allow excess oil to drain from the filter and wipe the frame.

(6) Install the filter as directed in *b* through *e* below. The arrow on the filter conforms to the flow of air through the vent.

b. Control-Indicator Cabinet Left-Side Air Intake Filter.

(1) Release the 12 latches around the air vent panel (fig. 72), and remove the 2 top shoulder screws and nuts.

(2) Raise the panel and disconnect the hinge on each side by removing the shoulder screw that connects each hinge to the panel. Lay the panel aside.

(3) Remove the 18 phillips-head screws that secure the vent to the cabinet.

(4) Lift the filter out of the vent and clean as directed in *a* above.

(5) Replace the filter in the vent, with the arrow pointing *in* toward the cabinet.

(6) Secure the vent to the cabinet with the 18 phillips-head screws and reconnect the 2 hinges with the 2 shoulder screws.

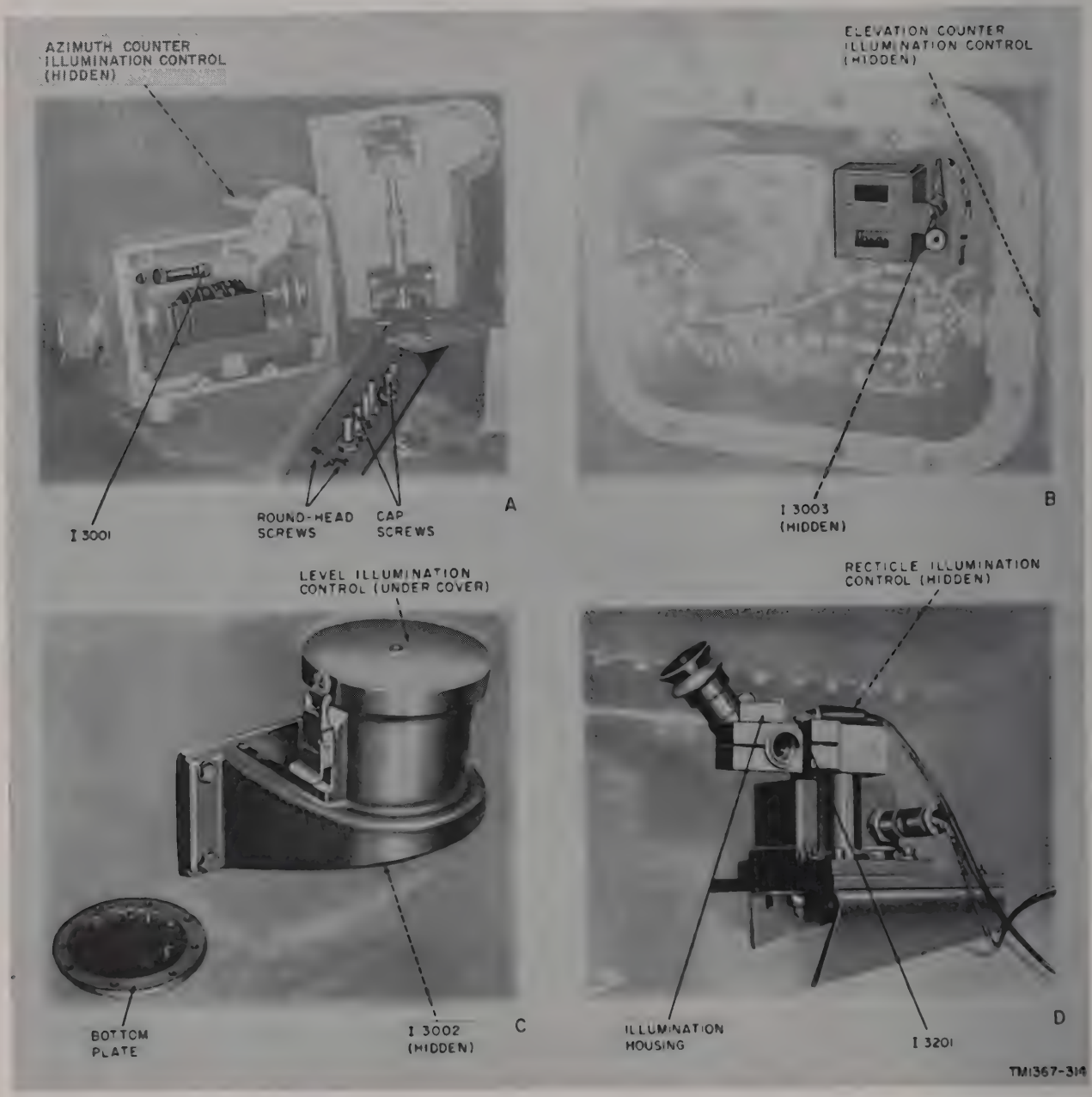


Figure 39. Antenna group lamp replacement.

(7) Secure the panel in place with the 2 shoulder screws and nuts and the 12 latches.

c. Control-Indicator Cabinet Right-Side Air Exhaust Filter.

(1) Release the 14 latches around the panel and remove the 2 top shoulder screws and nuts.
(2) Raise the panel and disconnect the hinge on each side by removing the shoulder screw that connects each hinge to the panel. Lay the panel aside.
(3) Remove the 13 phillips-head screws and 6 stop nuts that secure the vent to the cabinet.
(4) Lift the filter out of the vent and clean as directed in *a* above.
(5) Replace the filter in the vent, with the arrow pointing *out* from the cabinet.
(6) Secure the vent to the cabinet with the 13 phillips-head screws and 6 stop nuts.
(7) Reconnect the two hinges with the two shoulder screws.
(8) Secure the panel in place with the 2 shoulder screws and nuts and the 14 latches.

d. Receiver-Transmitter Cabinet Air Filters. There are two air filters located on the rear left-side of the cabinet and covered with one large panel (fig. 40). To remove and replace either filter, remove the panel and proceed as follows:

(1) Release the 13 latches around the panel and remove the 2 top shoulder screws and nuts.
(2) Raise the panel and disconnect the center hinge by removing the shoulder screw that connects it to the panel. Lay the panel aside.
(3) Remove the eight roundhead screws that secure the vent to the cabinet.
(4) Lift the filter out of the vent and clean as directed in *a* above.
(5) Replace the filter in the vent, with the arrow pointing *in* toward the cabinet.
(6) Secure the vent to the cabinet with the eight roundhead screws.
(7) Reconnect the center hinge with the shoulder screw.
(8) Secure the panel in place with the 2 shoulder screws and nuts and the 13 latches.

e. Dehydrator Air Filter.

(1) Release the six latches on the top cover of the cabinet. Lay the cover aside.
(2) Release the filter catch (fig. 71) by loosening the roundhead screw that secures it in place.
(3) Lift the filter from the vent and clean as directed in *a* above.
(4) Replace the filter in the vent and secure the filter catch by tightening the roundhead screw.
(5) Replace the cover on the cabinet and secure it with the six latches.

69. Radar Performance Test

The echo box furnished with each radar set is used to test overall system performance. Ringtime and afc operation can be checked by using the echo box in conjunction with the indicator B-scope.

a. Checking Ringtime. This check of the radar set range should be made daily and the results added to the chart similar to the one shown in figure 41. The absolute value of these readings is of little importance, but the comparison of day-to-day readings may show progressive deterioration of system effectiveness. Consistent charting of daily readings, therefore, is essential. The magnetron will change frequency throughout its operating life. As the magnetron deteriorates, the change in frequency will generally increase rapidly with operating time. Thus, it is often possible to anticipate the end of life for the magnetron. If readings of the RELATIVE POWER meter on the echo box are progressively lower day by day, the magnetron power output is probably decreasing. (The IN78 crystal detector in the echo box may be deteriorating. This should also be checked.) It is difficult to measure ringtime with any degree of accuracy. It is therefore of utmost importance that ringtime measurement be made as carefully as possible and preferably by the same observer each day. The accuracy required is shown by the fact that a 3-db decrease in receiver sensitivity will cause only a 50-meter decrease in ringtime. In this case, the magnetron power output would be reduced

one-half. Comments concerning replacement of any components that affect ringtime, such as the magnetron or the IN78 crystals, should be shown under REMARKS in figure 41. When these components are changed, it is necessary to readjust the echo box sensitivity potentiometer so that the readings are still in the center of the scale. This readjustment will have some effect on the succeeding day-to-day readings. To check ringtime, perform the following:

(1) Turn on the radar set as directed in paragraphs 50 and 51.

(2) Adjust the MAGNETRON CURRENT meter reading to 22 ma.

(3) Set the indicator RANGE SELECTOR switch to 10000M.

(4) Turn the MARKERS ON switch to ON.

(5) Tune the echo box until a presentation similar to the one shown in figure 42 is obtained on the B-scope.

(6) Rotate the EXPANDED SWEEP DELAY switch until the intensified band covers the area where the noise begins to build up.

(7) Carefully retune the echo box for a peak reading on the RELATIVE POWER meter.

(8) Rotate the computer LOWER BEAM RANGE control until the range strobe line coincides with the point where the noise first starts on the CRT.

(9) Set the indicator RANGE SELECTOR switch to 2500M and rotate the EXPANDED SWEEP DELAY switch to cover the start of the noise area.

(10) Repeat the procedure in (8) above for a more accurate placement of the strobe line.

(11) Read the RANGE counter on the computer to obtain the ringtime distance and record it on a chart similar to the one in figure 41. Compare the result with the previous readings.

(12) Record the transmitter frequency indicated on the echo box. The accuracy of this reading is ± 10 mcs.

b. Checking Afc Operation.

(1) With the equipment in operation, set the RANGE SELECTOR switch to 10000M.

(2) Tune the echo box for a peak reading on the RELATIVE POWER meter.

(3) Use the range strobe line to obtain the ringtime distance (*a* above) and note this reading.

(4) Place the control-monitor (fig. 23) A.F.C.-MANUAL switch in the MANUAL position and operate the L.O. CAVITY switch until maximum ringtime is obtained.

(5) Use the range strobe line to determine this distance, and note whether it has increased in comparison with the reading obtained during afc operation.

(6) If the reading has increased, the afc assembly is not working properly. Refer to paragraph 93*d*(18).

(7) Return the A.F.C.-MANUAL switch to A.F.C.

Note. The METER SENSITIVITY control on the echo box adjusts the meter to read between one-third and two-thirds of full-scale deflection. If the maximum readings obtained in (1) through (7) above do not fall within these limits, adjustment can be made with the METER SENSITIVITY control. Such an adjustment, however, will also have an effect on the daily meter readings and should therefore be made only if absolutely necessary.

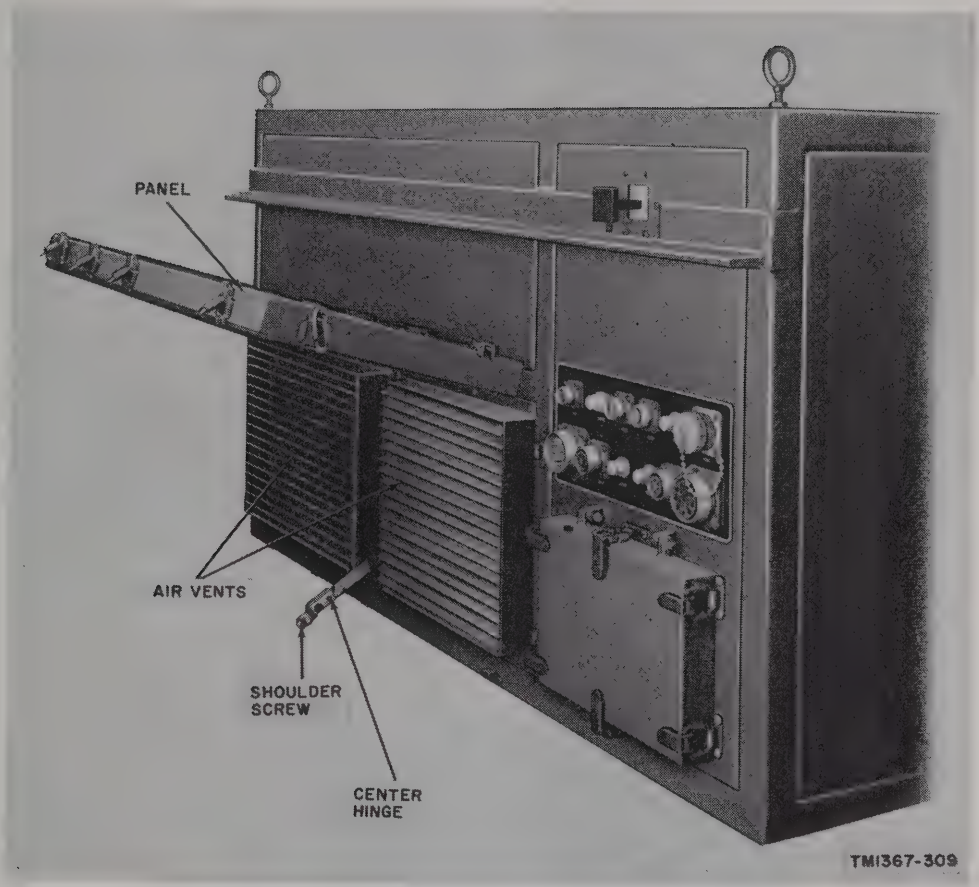


Figure 40. Receiver-transmitter cabinet, rear view

DAILY RECORD FORM FOR CHECKING RING TIME						
DATE	FREQUENCY (MC/S)	OPERATING TIME SINCE LAST READING	READING OF RELATIVE METER	RING TIME (METERS)	OBSERVER	REMARKS

NOTE:
MAGNETRON CURRENT METER READING SHOULD BE SET AT 22 MA.

TM1367-229

Figure 41. Daily record sheet for checking ringtime.

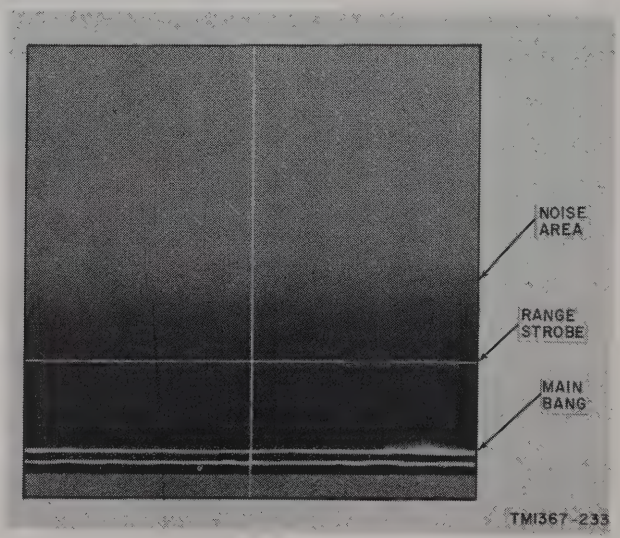


Figure 42. Echo box presentation on B-scope, showing ringtime.

CHAPTER 5
SECOND ECHELON MAINTENANCE

Section I. GENERAL MAINTENANCE PROCEDURES

70. Scope of Maintenance

a. Lubricate parts accessible without disassembly.

b. Replace easily accessible brushes and pluck-out parts.

c. Test and replace electron tubes.

d. Clean easily accessible commutators and sliprings.

e. Isolate faults.

f. Make adjustments on relays.

g. Burnish easily accessible contacts.

h. Repair cordage and wiring.

i. Tighten connections.

j. Splice with solder.

k. Retouch painted surfaces.

l. Perform basic field adjustments.

m. Observe and measure waveforms from available test stations.

n. Perform tests in accordance with equipment performance checklist.

o. Perform preventive maintenance as outlined on DA Form 11–238 (fig. 33).

71. Tools and Test Equipment Required

a. Tools.

Tool Equipment TE–113
Solder with rosin core; 1 pound spool, 1/8-inch diameter
Solder with rosin core; 1 pound spool, 1/16-inch diameter
Tape TL–83, friction, 3/4-inch wide
Tape TL–636/U, electrical, 3/7-inch wide

b. Tools Supplied with Radar Set.

Wrench, Spintite, 5/8-inch
Wrench, Spintite, 7/16-inch
Wrench TL–567/U, Allen, 1/16-inch
Wrench, Allen, 5/64-inch
Wrench, spanner, 1 1/4- to 3-inch
Wrench, spanner, 2- to 4 3/4-inch
Wrench, strap, 1/8- to 2-inch
Wrench TL–111, adjustable, 6-inch long
Wrench TL–112, 10-inch
Wrench, pawl fastener
Screwdriver, reversible, Allen No. 6 and 10

c. Test Equipment.

Electronic Multimeter TS–505A/U
Multimeter TS–352/U
Oscilloscope AN/USM–32
Electron Tube Test Set TV–7/U
Crystal Rectifier Test Set TS–268E/U

72. Unit Repairman's Preventive Maintenance

DA Form 11–238 (fig. 33) is a preventive maintenance checklist to be used by the unit repairman as directed by his commander. Items not applicable to the equipment are lined out in the figure. References in the ITEM block in the figure pertain to instructions below that contain additional information pertinent to the particular item. Refer to paragraphs 59 and 60 for a definition of preventive maintenance and the general techniques to be used.

Caution: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will become damaged or broken.

a. Check the completeness and general condition of all items stowed on the power unit trailer. These include carrying cases, cables, spare parts, accessories, and technical manuals. Accessories are listed in paragraph 15 and running spares are listed in paragraph 5*b*.

b. Check the suitability of location and installation for normal operation (par. 25). Note that the spirit level on the antenna is still leveled (par. 29*l*).

c. Remove dirt and moisture from the jacks and plugs on the various components. Remove dirt and debris from the radome window on the scanner output feed horns. Remove dirt from the area of the joint between the upper rotating and lower stationary portions of the pedestal.

d. Inspect the seating of fuses and indicator lamps on the control-power supply panel (fig. 28) and on the low-voltage power supply panel (fig. 24). Check the seating of tubes and crystals in the various components.

e. Inspect all controls on the radar set for binding, scraping, excessive looseness, misalinement, and positive action.

f. Check for normal operation (par. 77). Observe scanner assembly for any marked increase in vibration. This can be caused by an unbalanced scanner rotor and will result in damage to the assembly if operation is continued. During operation, note any audible changes in the scanner which can be caused by interference of moving parts in the rotor.

Caution: Disconnect all power before performing the following operations. Upon completion, reconnect the power and check for satisfactory operation.

g. Clean the exterior of cabinets and cases. Clean and tighten the coaxial transmision lines, waveguides, and cable connections. See that the blower panels fit snugly when closed. Tighten the bolts that secure the cabinets to the trailer frame.

h. Inspect the storage battery in the power unit for dirt, loose terminals, electrolyte level, specific gravity, and damaged case.

i. Clean nameplates, meter windows, and counter windows. Clean all air filters by immersing them in a shallow container filled with Cleaning Compound (par. 68).

j. Lubricate equipment in accordance with the lubrication instructions in paragraphs 73 and 74.

k. Inspect the power unit generator for brush wear, spring tension, arcing, and fitting of commutator.

l. Remove the battery before shipping or storing the power unit. Refer to TM 5–5264.

73. Lubrication Instructions for Radar Set AN/MPQ–4A

Lubrication instruction for Radar Set AN/MPQ–4A are shown in figures 43 through 46. Closeup views of lubrication points are illustrated in figures 47 through 50.

74. Detailed Lubrication Instructions

a. The type of lubricant to be used, the interval, and specific instructions for each part of the radar set are given in figures 43 through 46.

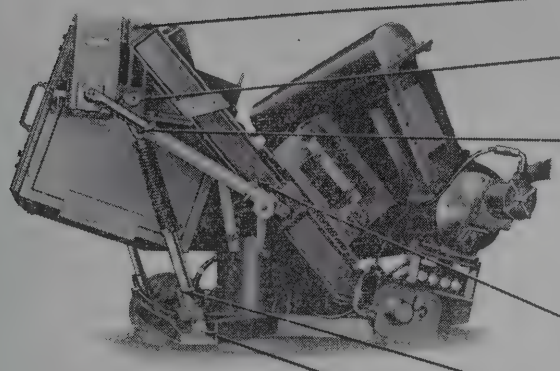
b. When the equipment is overhauled or repairs are made, parts should be cleaned with Cleaning Compound.

c. When Radar Set AN/MPQ–4A is dismantled for transportation, clean and lubricate all mounting hardware parts.

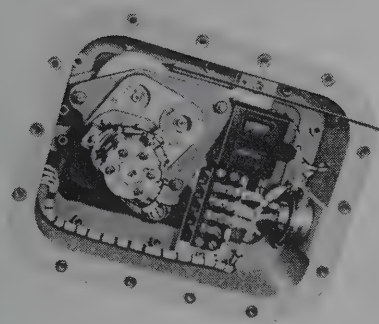
d. Do not use excessive amounts of oil or grease, and do not allow electrical connections to become greasy.

e. Be sure that lubricants and points to be lubricated are clean and free from sand, grit, and dirt. These abrasives are the chief cause of bearing wear and often make bearing replacement necessary. Use Cleaning Compound to clean all parts. Before lubricating, wipe all surfaces with a lint-free cloth moistened with Cleaning Compound. Keep solvent off surrounding parts.

f. Lubrication intervals designated are for normal 8-hour day operation. For abnormal conditions or activities, intervals should be shortened.



INTERVAL	LUBRICANT	
Q	GL	REFLECTOR PIVOT APPLY LIBERALLY.
Q	GL	REFLECTOR OPERATING LOCK APPLY LIBERALLY.
Q	GL	ELEVATION ACTUATOR PIVOT APPLY LIBERALLY.
	PL 2	SCANNER MOTOR FILL TO BOTTOM OF LEVEL PLUG. CHECK OIL LEVEL EVERY 500 HOURS OPERATION. CHANGE OIL EVERY 1,000 HOURS OPERATION.
S	PL 1	REFLECTOR HANDWHEEL FILL TO BOTTOM OF LEVEL PLUG.
S	PL 1	ELEVATION ACTUATOR FILL TO BOTTOM OF LEVEL PLUG.
Q	GL	ELEVATION ACTUATOR PIVOT APPLY LIBERALLY



INTERVAL	LUBRICANT	
S	PL 1	ELEVATION GEAR TRAIN APPLY SPARINGLY TO GEAR TEETH.

CLEANING-SOLVENT, DRY-CLEANING, ONLY WILL BE USED TO CLEAN PARTS, BEFORE LUBRICATING CLEAN EXPOSED SURFACES OF PARTS WITH LINT-FREE CLOTH LIGHTLY DAMPENED WITH SOLVENT, DRY-CLEANING. DO NOT ALLOW CLEANING FLUID TO GET ON OTHER PARTS.

KEY

LUBRICANTS	INTERVALS
GL-GREASE, MIL-G-3278	Q-QUARTERLY S-SEMIANNUALLY
PL 1-OIL, MIL-O-6081A GRADE 10D	
PL 2-OIL, DOW CORNING F61 SILICONE	

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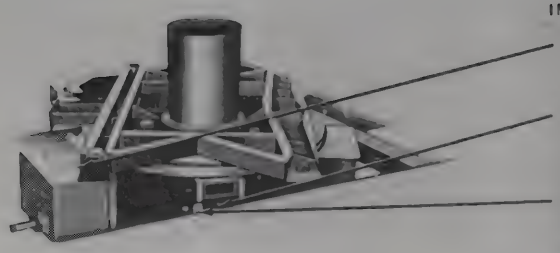
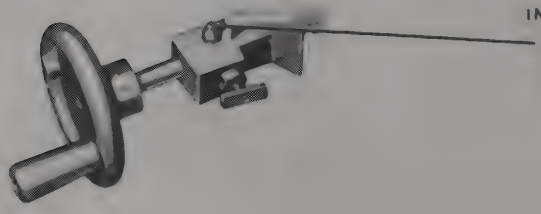
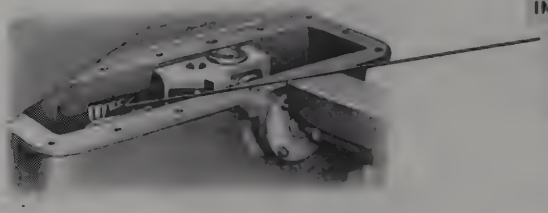
Figure 43. Lubrication instructions for elevation assembly.



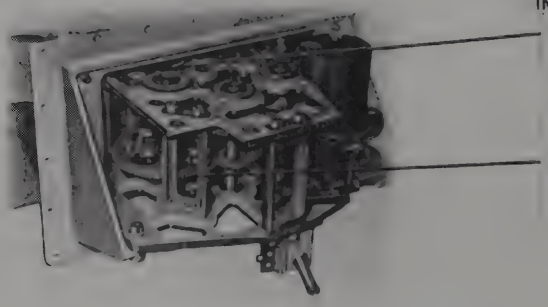
INTERVAL	LUBRICANT	
Q	GL	HOCKEY STICK PIVOT (2) APPLY LIBERALLY
S	GL	MAIN AZIMUTH BEARING (3) APPLY SPARINGLY, ROTATE TO SPREAD
Q	GL	PEDESTAL SUPPORT (3) APPLY LIBERALLY



INTERVAL	LUBRICANT	
Q	GL	AZIMUTH DRIVE SHAFT APPLY LIBERALLY, ROTATE TO SPREAD.



INTERVAL	LUBRICANT	
S	GL	AZIMUTH SYNCHRO GEAR TRAIN APPLY SPARINGLY WITH BRUSH



INTERVAL	LUBRICANT	
Y	GL	AZIMUTH MAIN GEAR APPLY SPARINGLY WITH BRUSH, ROTATE TO SPREAD
S	GL	AZIMUTH DRIVE GEAR APPLY SPARINGLY WITH BRUSH, ROTATE TO SPREAD.

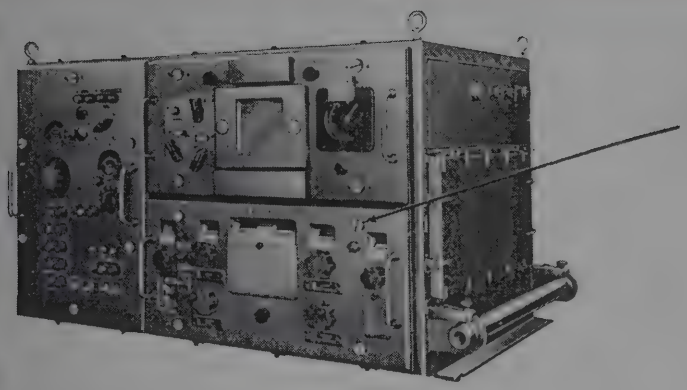
KEY

LUBRICANTS	INTERVAL
GL - GREASE, MIL-G-3278	Q – QUARTERLY S – SEMIANNUALLY Y – YEARLY

CLEANING - SOLVENT, DRY-CLEANING ONLY WILL BE USED TO CLEAN PARTS BEFORE LUBRICATING CLEAN EXPOSED SURFACES OF PARTS WITH LINT-FREE CLOTH LIGHTLY DAMPENED WITH SOLVENT, DRY-CLEANING. DO NOT ALLOW CLEANING FLUID TO GET ON OTHER PARTS.

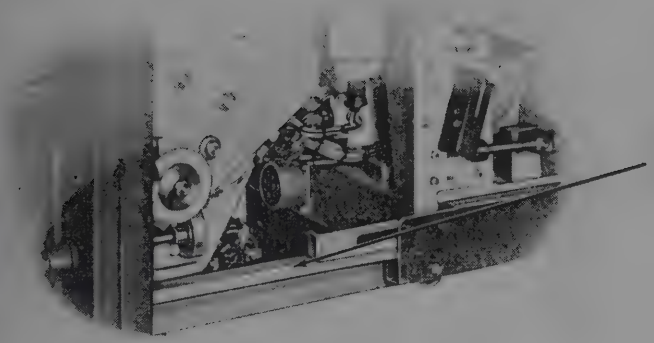
TM1367-267

Figure 44. Lubrication instructions for Antenna Pedestal AB–486/MPQ–4A.



INTERVAL LUBRICANT
S PL

PAWL FASTENERS
APPLY A FEW DROPS TO EACH OF THE 14 PAWL FASTENERS ON THE CABINET.



INTERVAL LUBRICANT
S GL

DRAWER SLIDES
APPLY SPARINGLY TO EACH OF THE 6 SLIDES IN THE CABINET.

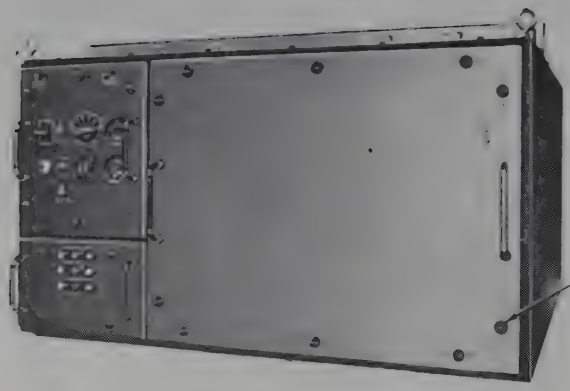
KEY

LUBRICANTS	INTERVAL
GL–GREASE MIL-G-3278	S–SEMIANNUALLY
PL–OIL, DOW CORNING F61 SILICONE	

CLEANING–SOLVENT, DRY–CLEANING ONLY WILL BE USED TO CLEAN PARTS. BEFORE LUBRICATING CLEAN EXPOSED SURFACES OF PARTS WITH LINT–FREE CLOTH LIGHTLY DAMPENED WITH SOLVENT, DRY–CLEANING. DO NOT ALLOW CLEANING FLUID TO GET ON OTHER PARTS.

TM1367–315

Figure 45. Lubrication instructions for Control-Indicator Group OA–1256/MPQ–4A.



INTERVAL LUBRICANT
S PL

PAWL FASTENERS
APPLY A FEW DROPS TO EACH OF THE 20 PAWL FASTENERS ON THE CABINET.

INTERVAL LUBRICANT
S GL

DRAWER SLIDES
APPLY SPARINGLY TO THE 2 SLIDES IN THE POWER SUPPLY DRAWER.

CLEANING-SOLVENT, DRY-CLEANING ONLY WILL BE USED TO CLEAN PARTS BEFORE LUBRICATING CLEAN EXPOSED SURFACES OF PARTS WITH LINT-FREE CLOTH LIGHTLY DAMPENED WITH SOLVENT, DRY-CLEANING. DO NOT ALLOW CLEANING FLUID TO GET ON OTHER PARTS.

KEY

LUBRICANTS	INTERVAL
GL-GREASE MIL-G-3278	S-SEMIANNUALLY
PL-OIL, DOW CORNING F61 SILICONE	

TM1367-316

Figure 46. Lubrication instructions for Receiver-Transmitter Group OA-1257/MPQ-4A.

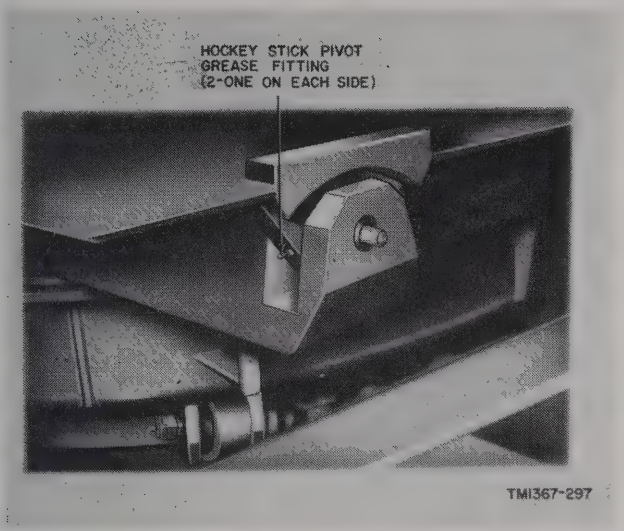


Figure 47. Hockey stick pivot, closeup of lubrication point.

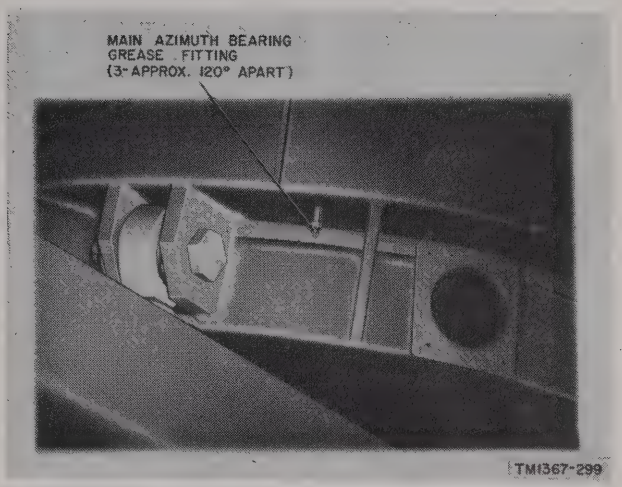


Figure 49. Pedestal main azimuth bearing, closeup of lubrication point.

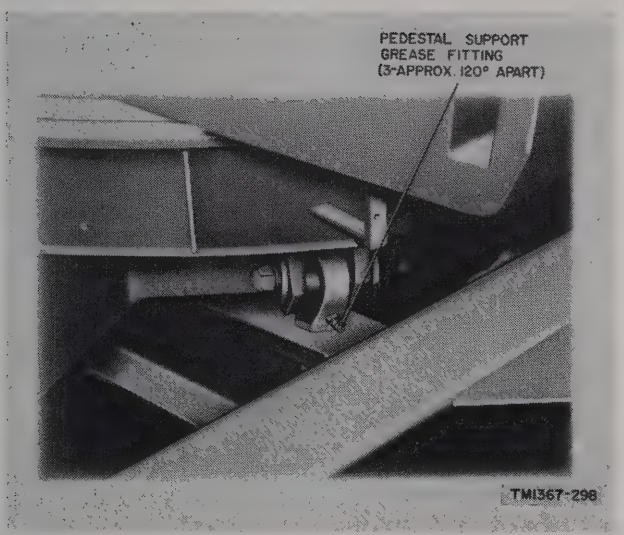


Figure 48. Pedestal support, closeup of lubrication point.

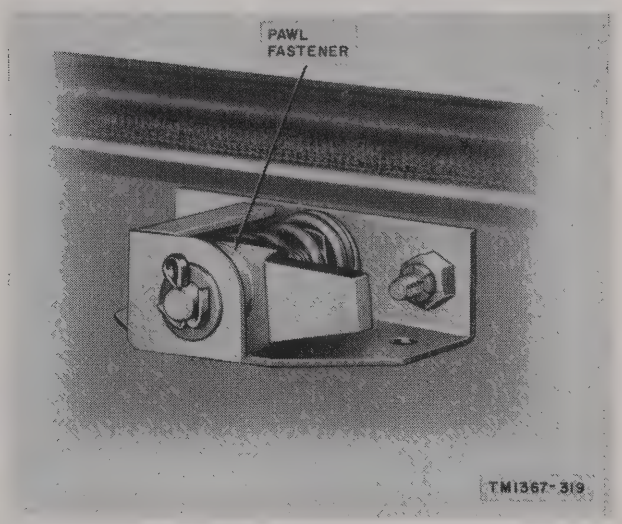


Figure 50. Cabinet pawl fastener, closeup of lubrication point.

Section II. TROUBLESHOOTING

75. Tube Testing Techniques

When trouble occurs, check all cabling, connection, and the general condition of the equipment *before* attempting to remove the electron tubes. Isolate the trouble, if possible, to a particular assembly or section of the equipment. If tube failure is suspected and a tube tester is not available, proceed as outlined in *b* below. If this procedure fails to clear the trouble, follow the procedure in *c* below.

Caution: *Do not rock or rotate* tube when removing it from its socket; *pull it straight out.* Rocking or rotating the tube causes the pins to bend, and may break the weld where the pins enter the glass. A high resistance or intermittent connection may also develop. Special precautions are necesary during replacement of tubes V101, V1105, and V1501. Refer to paragraph 79*c* for V101, paragraph 82*d* for V1105, and paragraph 83*c* for V1501 for the correct procedure to follow when removing these tubes.

a. Using Tube Tester

(1) Remove and test *one* tube at a time. If it becomes necessary to remove more than one tube at a time, label each one so that, if satisfactory, it can be replaced in its original socket.

(2) Replace a tube only when there is an obvious defect, such as broken glass envelope, open filament, broken lead, or broken connecting prong, or when a test in a tube tester or other equipment shows the tube to be defective.

(3) Do not discard a tube because it tests *on or near* its minimum test limit on the tube tester. Some new tubes test near the low end of the acceptability range of the tube specifications. These tubes provide satisfactory service over a long period of time, even though they remain at or near this low limit value.

(4) Do not discard a tube merely because it has been in use for a specific length of time. *Satisfactory operation in a circuit is the final proof of tube quality.*

b. Single Tube Substitution Method.

(1) Substitute a new tube for one of the suspected original tubes. If the equipment continues to be inoperative, replace the new tube with the original. Similarly check each original tube suspected, one at a time, until the defective tube is located and the equipment becomes operative. Discard the last original tube removed from the equipment. *Do not leave a new tube in a socket if the equipment operates satisfactorily with the original tube.*

(2) If this method of tube substitution does not correct the trouble, try the method described in *c* below.

c. Multitube Substitution Method. Occasionally two or more tubes are defective in a piece of equipment. In such cases, it is necessary to install new tubes, one at a time, until the equipment becomes operative. This should be done as follows:

(1) Remove one of the suspected original tubes. Install a new tube. If the equipment is still inoperative, leave the new tube in place and remove the next suspected original tube. Install another new tube. Mark the original tubes with the numbers on the sockets from which they are removed. Continue this procedure until the equipment becomes operative. The last original tube removed is defective and should be discarded.

(2) To determine whether another original tube is defective, return one of them to its original socket. If there is no noticeable difference in performance, leave the original tube in the equipment. In the same way, return the remaining tubes to their sockets, one at a time. If equipment failure occurs, or performance suffers, discard the last original tube installed. *Do not leave a new tube in a socket if the equipment operates satisfactorily with the original tube.*

d. Turn In for Repair. If none of the procedures outlined above restore the equipment to normal operation, *return the original tubes to their sockets* before forwarding the defective item of equipment to a higher echelon for repair.

76. Use of Equipment Performance Checklist

a. General. The equipment performance checklist (par. 77) will help the unit repairman to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take.

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check normal indications.

c. Normal Indications. The normal indications listed include the visible or audible signs that the unit repairman should perceive when he checks the items. If these signs are not normal, the unit repairman should apply the corrective measures.

d. Corrective Measures. The corrective measures listed are those the unit repairman can make without turning in the equipment for repairs. A reference in the table to paragraph 78 indicates that the trouble cannot be corrected during operation and that trouble shooting is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, troubleshooting is necessary.

Note. Before using the equipment performance checklist, refer to paragraph 88 on the interlock circuits.

77. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Cables	Check connections (par. 35).	No disconnected cables	Tighten or connect.
	2	Drawers and front panels.	Must be closed	System operates and MAIN POWER ON & INTLK CLOSED lamp lights when set is energized.	Close doors and drawers securely Check interlocks (par. 88).
	3	Blower panels	Must be open	System operates and MAIN POWER ON & INTLK CLOSED lamp lights when set is energized.	Open panels (par. 50*f*).
START	4	POWER UNIT switch (S653).	Depress to START	POWER UNIT lamp lights	Replace lamp. Check item 1. Throw switch to STOP. Interchange any two phases of the three-phase unit by means of lug terminals. See TM 5–5264.
	5	MAIN POWER switch (S652).	Turn to ON	MAIN POWER ON & INTLK CLOSED lamp lights. 120 V AC blown fuse lamps do not light. READY lamp lights after 5 minutes.	Replace MAIN POWER ON & INTLK CLOSED and READY lamps. Check items 2 and 3. Replace FUSE 5 AMP (fig. 27).

Item No.	Item	Action or condition	Normal indications	Corrective measures
6	Blowers	Turn MAIN POWER switch to ON	Two blowers in receiver-transmitter and one blower in control-indicator operate.	Check 120 V AC blown fuse indicator lamps (fig. 27).
7	ELEVATION switch (S655).	Operate first in RAISE, then in LOWER position.	Reflector first moves down, and then moves up.	Check item 1. Check connections to antenna elevation motor. Check 120 V AC blown fuse indicator lamps (fig. 27).
8	AZIMUTH switch (S656).	Operate first in CW, and then in CCW position.	Antenna should move in azimuth correspondingly.	Check item 1. Check stowlock (fig. 13). Check connections to azimuth drive motor. Check 120 V AC blown fuse indicator lamps (fig. 27).
9	DEHYDRATOR	Hinge up air intake cover on front panel.	Pressure gage reads approximately 12 psi.	Check hose connection to wave guide.
			Dry air indicator shows blue	Replace desiccant chamber if indicator shows pink. (par 87).
10	START switch (S658).	Press START button	RADIATE lamp lights	Replace RADIATE lamp. See that transmitter door is tightly closed. Check dehydrator pressure. Check interlocks (par. 88).
11	MAGNETRON POWER control (T651).	Adjust for normal magnetron current.	MAGNETRON CURRENT meter reads 22 ma.	Check for defective meter. Refer to paragraph 78.
12	TEST METER SELECTOR switch (S651).	Rotate switch to AFC XTAL CUR.	TEST METER reads 2.5 ±.5	Replace afc crystal CR1503 (par. 85).
13	TEST METER SELECTOR switch (S1401).	Rotate switch to XTAL 1.	TEST METER reads 2.5 ±.5	Replace CR1501 (par. 85).
		Rotate switch to XTAL 2.	TEST METER reads 2.5 ±.5	Replace CR1502 (par. 85).
14	L. O. RAISE LOWER switch (S654).	Set A.F.C.-MANUAL switch on control-monitor to A.F.C. On control-power supply, set AFC - MANUAL switch to MANUAL. Depress L. O. RAISE LOWER switch up or down as required.	Maximum video signal on B-scope.	Check klystron motor connections. If motor is not tuning oscillator, check wiring to AFC-MANUAL and L.O. switches on control-power supply and control-monitor.
		Set control-power supply AFC - MANUAL switch to AFC.	No change in video signal on B-scope.	Check afc crystal current and replace crystal if necessary. Refer to paragraph 85.
15	Indicator B-scope (V101).	Observe screen with RANGE SELECTOR switch in 10000M position.	Screen should have visible raster.	Adjust INTENSITY control R142 (fig. 25) and AUXILIARY INTENSITY control R110 (fig. 76) for desired raster brightness. Adjust AZIM SYNCH GAIN control R547 (fig. 77) so that a stable raster and azimuth strobe line occur together. HV ADJ R164 (fig. 77) should be fully cw. Adjust FOCUS control R121 for sharpest picture images. Adjust SWP INTEN ADJ control R4657 (fig. 77) for desired sector band intensity.

Item No.	Item	Action or condition	Normal indications	Corrective measures
15			Raster should extend slightly beyond visible portion of CRT face in vertical and horizontal directions.	Adjust VERT. SIZE 10000M control R104 (fig. 76) to extend picture upward. Adjust VERTICAL CENTERING control R4409 (fig. 76) to center horizontal base line. Adjust HOR SIZE control R4536 to extend picture laterally. Adjust HOR CENTERING control R4517 to center picture.
			Intensified band should be 2,500 meters wide.	Adjust SWP SIZE ADJ control R4660 (fig. 77). Refer to paragraph 78 if above adjustments are not satisfactory.
16	EXPANDED SWEEP DELAY switch (AT101).	Switch from 0 through 10 consecutively.	Intensified portion of sweep should move from bottom to top of screen in successive steps of 1,000 meters.	Refer to paragraph 78.
17	RANGE SELECTOR switch (S101).	Return EXPANDED SWEEP DELAY switch to 0 position and switch RANGE SELECTOR switch to 2500M position.	Full vertical sweep representing 2,500 meters in range.	Adjust INTENSITY BALANCE control R112 until raster brightness for short range is equal to that of long range.
			Vertical size should be extended slightly beyond visible portion of CRT.	Adjust VERT. SIZE 2500M control R106. Refer to paragraph 78 if adjustments are not satisfactory.
18	VIDEO control (R102).	Turn control fully on	Increases signal and noise intensity on scope screen.	Refer to paragraph 78.
19	IF GAIN control (R109).	Turn control cw or ccw.	Signal and noise intensity increases with cw rotation, decreases with ccw rotation. Set to threshold of noise with VIDEO control fully ccw.	Refer to paragraph 78.
20	Range controls	Turn MARKERS switch (S105) to ON.	Markers occur at 2,000, 4,000, 6,000, 8,000 and 10,000 meters if system is radiating, afc is properly locked on, and receiver gain is sufficient.	Refer to paragraph 78.
		Turn RANGE MARK control R103 cw or ccw.	Adjusts intensity of range marker as desired.	Refer to paragraph 78.
21	AZIMUTH MARK control (R132).	Turn control cw or ccw.	Adjusts intensity of azimuth strobe line as desired.	Refer to paragraph 78.
22	RANGE SHIFT switch (S103).	Switch to ON	Displaces upper beam raster 500 meters above lower beam raster.	Adjust RANGE SHIFT control R4560 (fig. 76). If necessary refer to paragraph 78.
23	BEAM VIDEO switch (S110).	Switch to BOTH position. Operate ELEVATION switch until a convenient lower beam fixed target appears on CRT.	Target appears on screen	Refer to paragraph 78.
		Switch S110 to UPPER position.	Target disappears from screen	Refer to paragraph 78.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE			DEPRESS ELEVATION switch to LOWER until upper beam video is obtained on CRT.	Target reappears on screen	Refer to paragraph 78.
			Switch S110 to LOWER position.	Target disappears from screen	Refer to paragraph 78.
	24	TIMER switches (S106 and (S107).	With S110 in BOTH position, operate ELEVATION switch until a convenient lower beam fixed target appears on CRT.	Clock starts and target disappears from screen.	Check Clock M101. Check connections to switches. Refer to paragraph 78.
			Switch S110 to LOWER and press either TIMER button.		
			Depress ELEVATION switch to LOWER until the target reappears as upper beam video. Press either TIMER button.	Clock stops and target disappears from screen.	Same as above.
STOP	25	RESET switch (S108).	Press to reset clock to zero.	Clock hands will return to zero	Check switch connections.
	26	PLOTTER DIMMER control (R113).	Turn cw or ccw to vary illuminations of plotter scale.	Illumination will vary with rotation of control.	Replace illumination lamps (par. 67).
	27	PANEL DIMMER control (R133).	Turn cw or ccw to vary illumination of front panel.	Illumination will vary with rotation of control.	Replace illumination lamps (par. 67).
	28	STOP switch (S659).	Press STOP button	RADIATE lamp goes out. Transmitter inoperative.	Check switch S659.
	29	MAIN POWER switch (S652).	Switch to OFF	READY and MAIN POWER ON & INTLK CLOSED lamps go out. Radar set inoperative.	Check switch S652
	30	POWER UNIT switch (S653).	Switch to STOP	POWER UNIT lamp goes out	Check switch S643.

78. Tube Troubleshooting Chart

a. General. Before replacing any tubes, refer to the tube testing techniques (par. 75). When replacing tubes, refer to the tube location diagram for the specific assembly.

b. Chart.

Item No.	Symptoms	Tubes and location
1	Abnormal reading on control-power supply TEST METER with:	
	TEST METER SELECTOR switch in +440V position.	V601, V602, V603, V615 (fig. 60 and 61).
	In +220V position.	V604, V605, V606, V607, V608, V609, V614.
	In −220V position.	V610, V611, V612, V613.
2	Abnormal reading on control - monitor TEST METER with:	
	TEST METER SELECTOR switch in +300V position.	V1602, V1606, V1610 (fig. 69).
	In +150V position.	V1603, V1604, V1607, V1608, V1611.
	In −300V position.	V1605, V1609, V1612.
3	No picture or screen illumination with full intensity.	V101 (par. 79*c*), V161 (par. 79*a*).
4	Insufficient or no vertical sweep on CRT.	V201–V204, V231–V235 (fig. 52), V4401–V4405 (fig. 55).
5	Insufficient or no horizontal sweep on CRT.	V501–V508 (fig. 54), V4501–V4508 (fig. 55).
6	Insufficient or no video on CRT.	V4601, V4602, V4603, V4604 (fig. 55).
7	Insufficient or no range markers.	V401, V402, V403, V404 in range marker trigger pick-off ampl (fig. 53).
8	Insufficient or no 2,500-meter intensified band.	V401–V404 in delay trigger pick-off ampl (fig. 53).
		V4651–V4655 (fig. 54).
9	Insufficient or no azimuth strobe lines.	V4652 (fig. 54).
10	System does not radiate. No modulator triggers to transmitter.	V401–V404 in range zero trigger pick-off ampl (fig. 53) and V4571–V4573 (fig. 52).
11	Insufficient or no video beam selection.	V4551 (fig. 52).
12	Retrace lines on CRT.	V4654, V4655 (fig. 54).
13	MAGNETRON CUR meter reads less than normal (22 ma): Disconnect J1151. If no change, check tubes.	V1151, V1152, V1153, V1154 (fig. 63), and V1104 (fig. 62).
14	MAGNETRON CUR meter reads zero or nearly zero. (Normal vertical sweep on CRT with RANGE SELECTOR switch in 2500M position.)	V401–V404 in range zero trigger pick-off ampl (fig. 53), V1153 (fig. 63), and V1106 (fig. 62).
15	MAGNETRON CUR meter reading jumps erratically.	V1106 (fig. 62).
16	Thyratron receiving no trigger causing magnetron current reading to be zero.	V1151, V1152, V1153, V1154, and V1155 (fig. 63).
17	No reading at AFC OUTPUT jack.	V1306 (fig. 65).
18	Normal reading AFC OUTPUT jack. No afc crystal current on TEST METER.	CR1503 (par. 85) and V1501 (fig. 68).
19	No range calibration output. AFC OUTPUT reading normal.	V1302 (fig. 65).
20	Reverse current overload relay K1102 drops out.	V1103, V1104, V1105, V1106 (fig. 62).
21	High-voltage overload relay K1101 drops out.	V1101, V1102 (fig. 62).
22	Magnetron filament overload relay K1103 drops out.	V1105 (fig. 62).
23	Abnormal arcing in magnetron not cured by replacing magnetron.	V501 (fig. 54).
24	Azimuth marker does not move when either LOWER BEAM AZIMUTH or Δ AZIMUTH controls are rotated.	(Component viewed from front). First chassis from left, either of the two tubes nearest the front panel (fig. 51).
25	Different values of Δ TIME or LOWER BEAM ELEVATION angle do not change computer solution. *C* goes to upper limit and DOUBTFUL SOLUTION lamp lights.	Second chassis from left, either of the two tubes nearest the front panel; sixth chassis from left, any tube (fig. 51)[a].
26	AZIMUTH counter does not change after once setting in information.	Fourth chassis from left, either of the two tubes farthest from the front panel (fig. 51)[a].
27	AZIMUTH counter does not move when antenna is changed in azimuth.	First chassis from left, either of the two tubes farthest from the front panel (fig. 51)[a].
28	RANGE counter does not change after once setting in information.	Third chassis from left, either of the two tubes farthest from the front panel (fig. 51)[a].

Item No.	Symptoms	Tubes and location
29	ELEVATION counter does not move when antenna is moved in elevation.	Second chassis from left, either of the two tubes farthest from the front panel (fig. 51)[a].
30	Azimuth strobe line changes position from where it was last seen on the scope.	Fifth chassis from left, either of the two tubes (fig. 51).
31	WEAPON LOCATION EASTING and NORTHING counters go to limit stops.	Fifth chassis from left, either of the two tubes nearest the front panel (fig. 51).
32	WEAPON LOCATION EASTING counter goes to limit stop.	Third chassis from left, either of the two tubes nearest the front panel (fig. 51)[a].
33	WEAPON LOCATION NORTHING counter goes to limit stop.	Fourth chassis from left, either of the two tubes nearest the front panel (fig. 51)[a].

[a] To facilitate maintenance and troubleshooting, this plug-in chassis is interchangeable with any one of the other three servo amplifier chassis. Also, each chassis mounts two identical amplifiers which may be interchanged by rotating the chassis 180°.

79. Indicator Tube Replacement

a. General.

(1) Change one tube at a time. Be sure that the correct tube is replaced in the proper socket.

(2) To gain access to the indicator tubes, loosen the four captive screws on the front panel and pull out the drawer. All tubes except V101 (*c* below) and V161 are readily accessible. Tube V161 is located on the bottom left-hand panel (fig. 37). Refer to figures 76 and 77 for the chassis layout.

b. Tube Complement.

Symbol	Tube type	Function
	High-voltage circuit	
V161	6L6WGB	High-voltage oscillator.
	Long gate generator (fig. 52)	
V201A	12AT7WA	Oscillator.
V201B	----------	Regenerative amplifier.
V202A	12AT7WA	Gate cathode follower.
V202B	----------	Regenerative amplifier.
V203A	5726/6AL5W	Diode clamp.
V203B	----------	Trigger coupling.
V204A	12AT7WA	Gate generator.
V204B	----------	Gate shutoff.
	Timing sweep generator (fig. 52)	
V231	5725/6AS6W	Gated Miller sweep.
V232	12AT7WA	Cascode amplifier.
V233	12AT7WA	Cathode follower.
V234A	5726/6AL5W	Gate shutoff.
V235B	----------	Dc restorer.
V235	12AT7WA	Cathode follower.
	Pickoff amplifiers (fig. 53)	
V401 (3)	5726/6AL5W	Comparator.
V402 (3)	6AU6WA	Amplifier.
V403 (3)	12AT7WA	Regenerative amplifier.
V404 (3)	12AT7WA	Blocking oscillator
	Azimuth synchronizer (fig. 54)	
V501	5814A	Trigger blanking amplifier.
V502	12AT7WA	Blanking multivibrator.
V503A	12AT7WA	Range shift amplifier.
V503B	----------	Azimuth gate amplifier.
V504	12AT7WA	Range shift multivibrator.
V505	12AT7WA	Reference amplifier.
V506A	12AT7WA	Blanking trigger amplifier.
V506B	----------	Synchronizing marker amplifier.
V507A	12AT7WA	Inverter amplifier.
V507B	----------	Cathode follower.
V508	12AT7WA	Azimuth strobe multivibrator.
	Range sweep generator (fig. 55)	
V4401A	12AT7WA	Sweep generator.
V4401B	----------	Voltage-setting triode.
V4402A	5726/6AL5W	Clamp for V4401A.
V4402B	----------	Clamp for V4401A.
V4403	6AU6WA	Phase inverter.
V4404	6L6WGB	Range sweep driver.
V4405	6L6WGB	Range sweep driver.
	Azimuth sweep generator (fig. 55)	
V4501A	5726/6AL5W	Clamp for V4502.
V4501B	----------	Clamp for V4502.
V4502	6AU6WA	Sweep generator.
V4503	6005/6AQ5W	Azimuth driver.
V4504	6005/6AQ5W	Azimuth driver.
V4505	6AU6WA	Phase inverter.
V4506	6005/6AQ5W	Azimuth driver.
V4507	6005/6AQ5W	Azimuth driver.
V4508A	12AT7WA	Automatic size control.
V4508B	----------	Automatic size control.

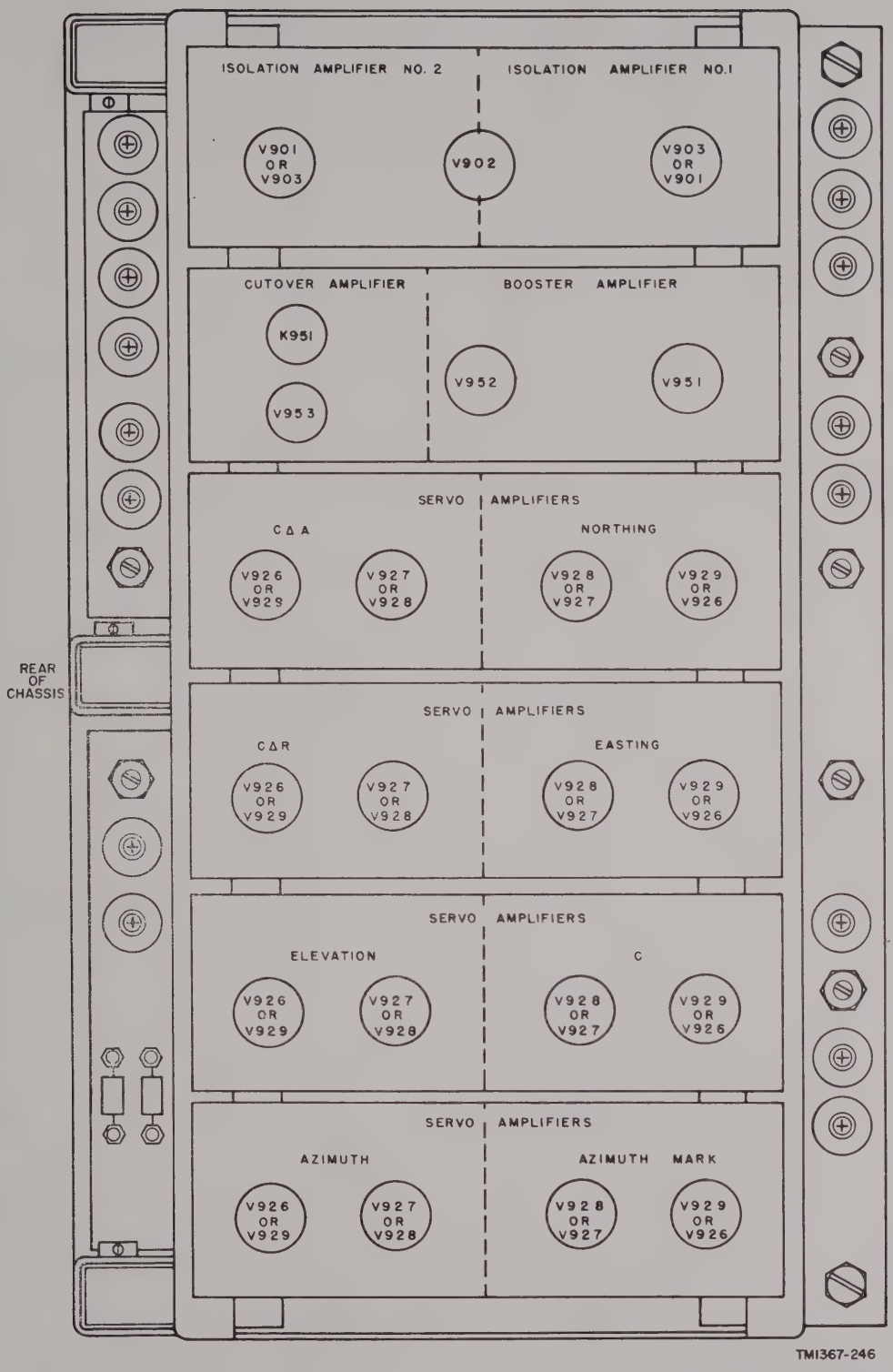


Figure 51. Computer, partial top view showing chassis layout.

Symbol	Tube type	Function
	Video blanking (fig. 52)	
V4551	12AT7WA	Beam blanking amplifier.
	Modulator trigger generator (fig. 52)	
V4571	5725/6AS6W	Gated trigger amplifier.
V4572	5687	Modulator trigger.
V4573	6005/6AQ5W	Focus current regulator.
	Video amplifier (fig. 55)	
V4601	5725/6AS6W	1st video amplifier and blanking tube.
V4602	6AU6WA	2d video amplifier.
V4603	6005/6AQ5W	3d video amplifier.
V604	5725/6AS6W	Range strobe sharpener.
	Intensifier and short gate generator (fig. 54)	
V4651A	12AT7WA	Delay trigger amplifier.
V4651B	----------	Cathode follower.
V4652A	12AT7WA	Short gate inverter amplifier.
V4652B	----------	Cathode follower.
V4653	12AT7WA	Short gate multivibrator.
V4654	5725/6AS6W	Intensity mixer.
V4655	12AT7WA	Intensifier amplifier.

Caution: Shut off all power to component before removing tubes.

c. Replacement of Cathode-Ray Tube V101 (fig. 56). Be extremely careful when handling the cathode-ray tube (crt). Use both hands when lifting the tube; never lay it down on hard surfaces. Be careful not to drop tools on the tube. Wear safety glasses and gloves. To replace the tube, proceed as follows:

(1) Loosen the four captive screws on the indicator panel and slide out the drawer. The high-voltage anode cap is located on the bottom front of the indicator (fig. 77).

Caution: The anode cap and the high-voltage anode may retain a small amount of static voltage. Discharge both the anode cap and the anode to ground to remove this static voltage.

(2) Disconnect the anode cap.

(3) Place a felt pad on a level surface to prevent scratches and damage to the detail parts of the plotter.

(4) Remove the eight phillips-head screws from the indicator plotter cover and lift off the cover (1, fig. 56).

(5) Lift out the plexiglass window and the two neoprene gaskets (2, fig. 56).

(6) Remove the four screws around the plotter ring and remove the plotter ring (3, fig. 56).

(7) Lift out the aluminum spacer plate (4, fig. 56) and remove the glass mirror (5, fig. 56).

(8) Remove the two aluminum spacer plates (6, fig. 56), the metal frame (7, fig. 56), and the rubber tube cushion (8, fig. 56).

(9) Pull out the tube; use one hand to support the tube front and the other to pry between the tube base and the socket.

(10) Insert the new tube in the socket, and seat it securely.

(11) Replace the rubber tube cushion (8), the metal frame (7), and the two aluminum spacer plates (6) in the order named.

(12) Replace the mirror (5), observing the marking, THIS SIDE UP, and replace the aluminum spacer plate (4).

(13) Place the plotter ring (3) in position and secure it with the appropriate four screws. These screws should hold the plotter ring firmly against the tube without excessive tightness or looseness.

(14) Replace the plexiglass window and the two neoprene gaskets (2).

(15) Place the plotter cover (1) in position and secure it with the eight phillips-head screws.

(16) Adjust the thumb nuts on the threaded shafts at the rear of the tube (fig. 76) to compensate for any difference in length of tubes.

(17) Reconnect the crt anode cap on the bottom front of the indicator.

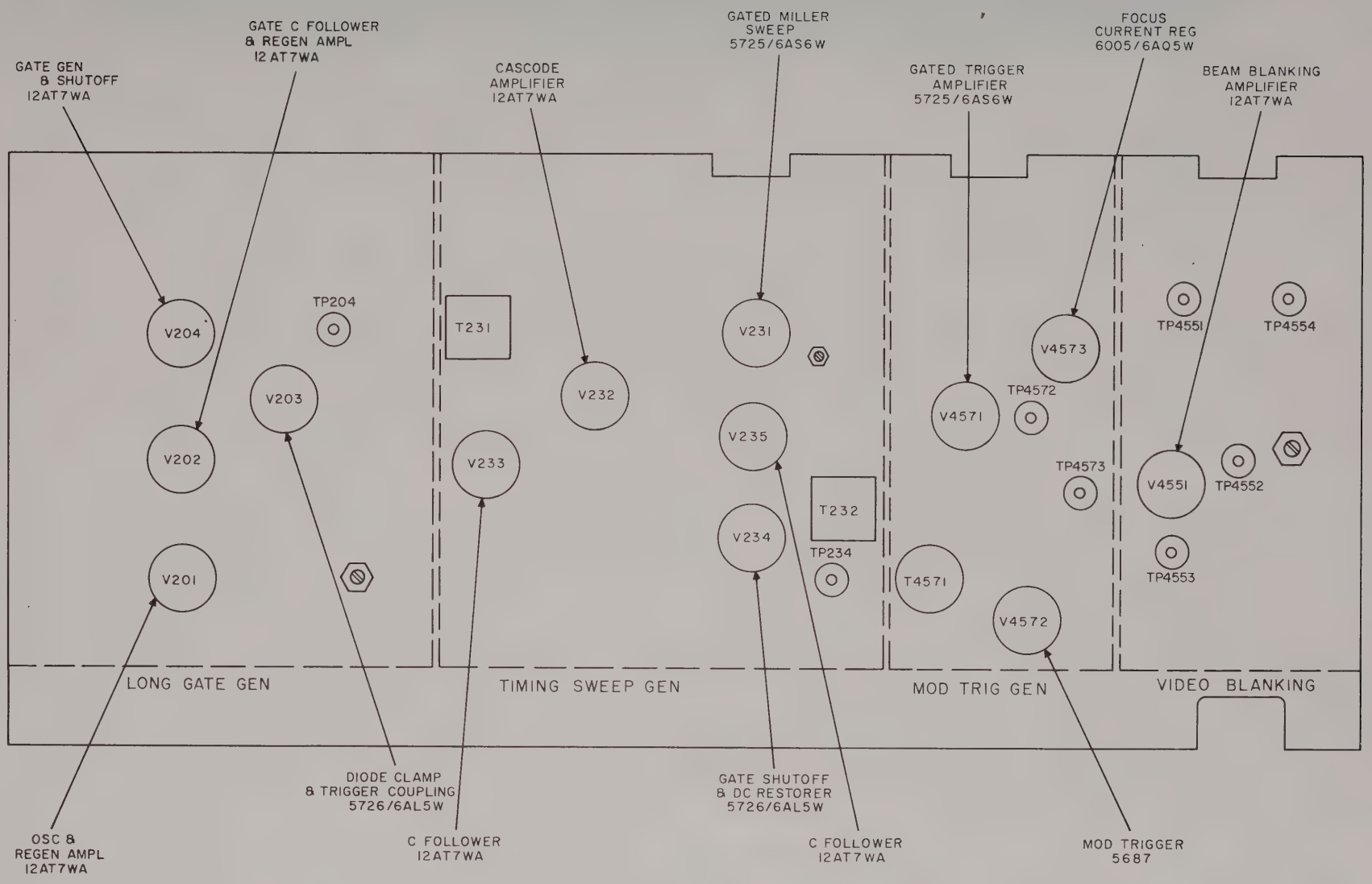


Figure 52. Long gate, timing sweep, modulator trigger, and video blanking chassis, top left panel, tube location diagram.

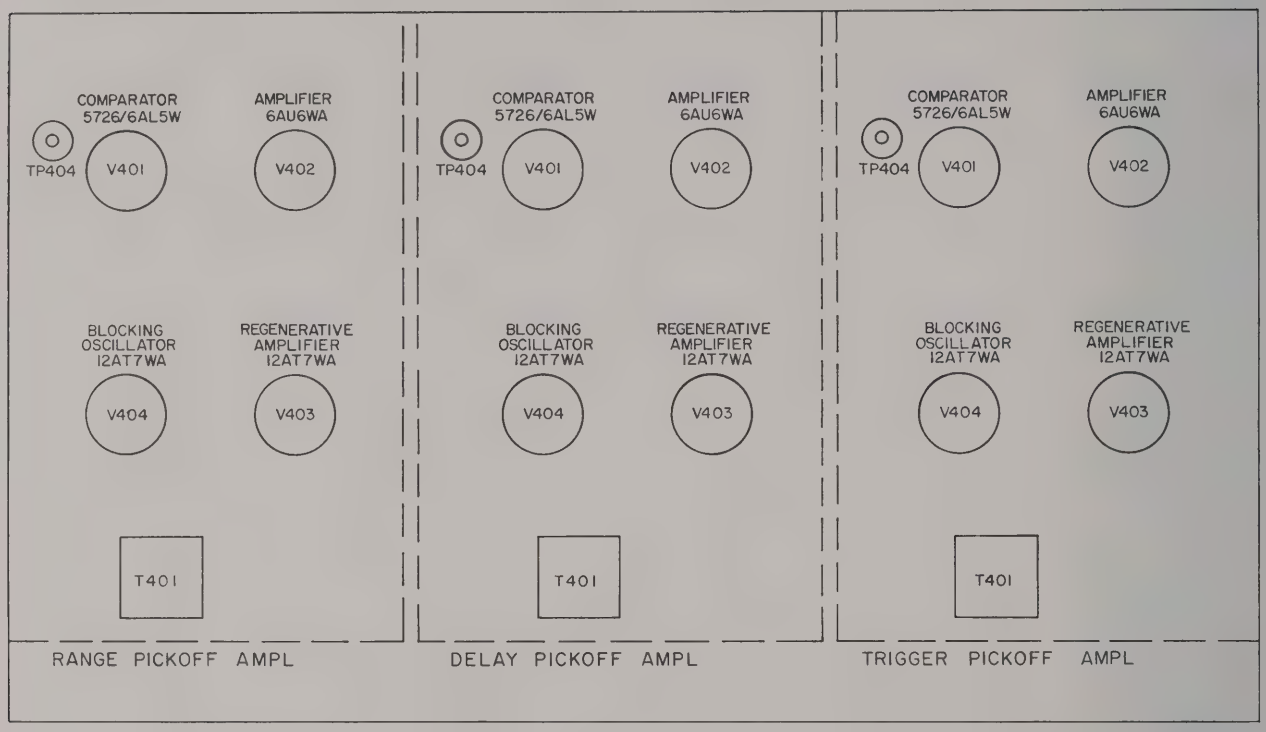


Figure 53. Pick-off amplifiers chassis, bottom left panel, tube location diagram.

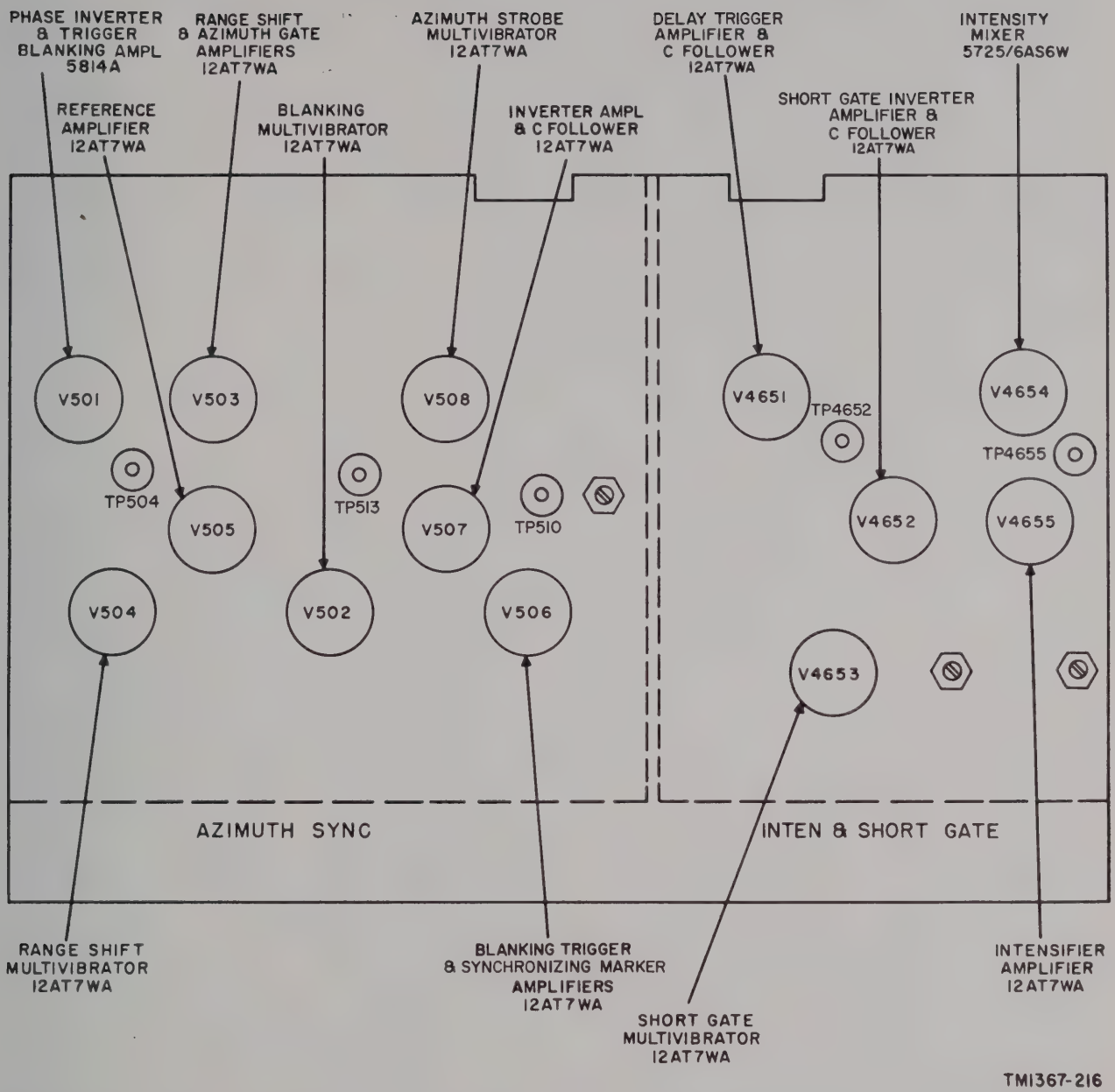


Figure 54. Azimuth synchronizer, intensifier and short gate chassis, bottom right panel, tube location diagram.

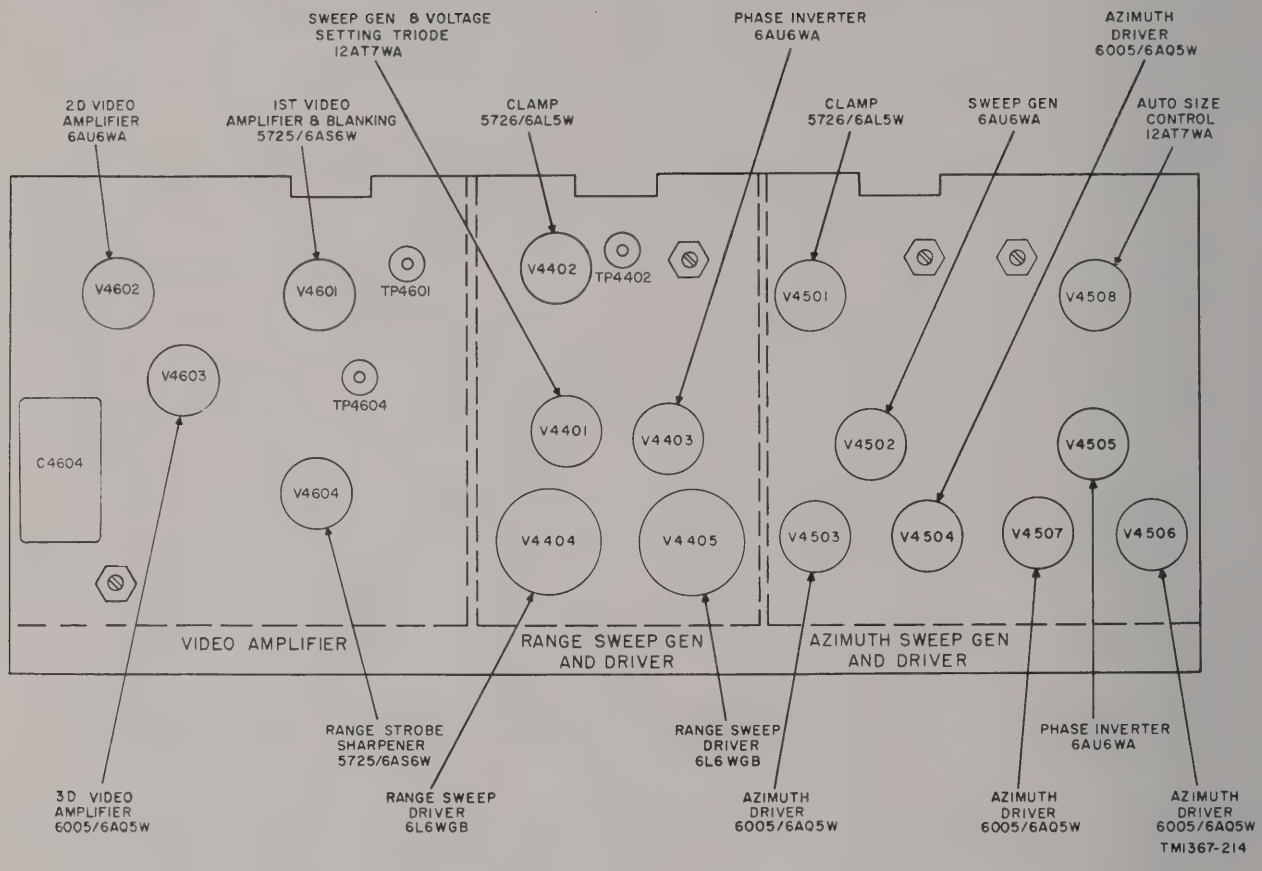


Figure 55. Sweep generators and video amplifier chassis, top right panel, tube location diagram.

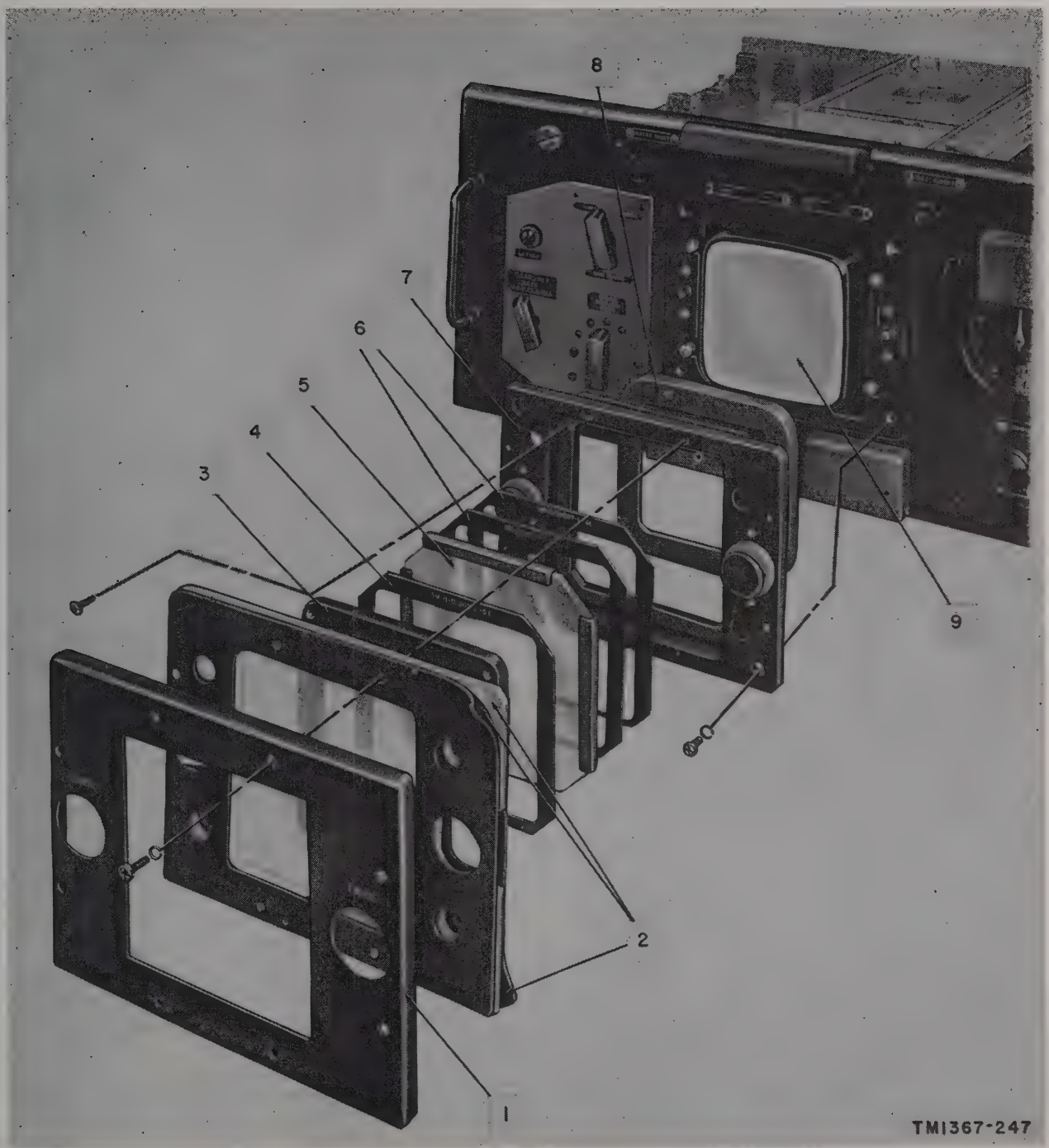


Figure 56. Removal of cathode-ray tube.

80. Computer Tube Replacement

a. General. To gain access to the computer tubes, loosen the four captive screws on the front panel and pull out the drawer. Refer to figure 51 for chassis layout.

b. Tube Complement.

Symbol	Tube type	Function
	Isolation amplifier (fig. 57)	
V901	5751	Two-stage voltage amplifier.
V902	5814A	Two single-stage amplifiers.
V903	5751	Two-stage voltage amplifier.
	Servo amplifiers (fig. 58)	
V926 (4)	5751	Two-stage voltage amplifier.
V927 (4)	12AT7WA	Push-pull amplifier.
V928 (4)	12AT7WA	Push-pull amplifier.
V929 (4)	5751	Two-stage voltage amplifier.
	Booster amplifier (fig. 59)	
V951	12AT7WA	Two-stage voltage amplifier.
V952	12AT7WA	Parallel output stage.
	Dual speed cutover amplifier (fig. 59)	
V953	12AT7WA	Voltage amplifier and cathode follower.

81. Control-Power Supply Tube Replacement
(figs. 60 and 61)

a. General. To gain access to the control-power supply tubes, loosen the four captive screws on the front panel and pull out the drawer in the control-indicator cabinet. The tubes are located on the right- and left-hand sides of the vertically mounted chassis.

b. Tube Complement.

Symbol	Tube type	Function
V601	5R4WGA	+440-volt rectifier.
V602	5933	+440-volt control tube.
V603	6AU6WA	+440-volt amplifier.
V604	5R4WGA	+220-volt rectifier.
V605	5R4WGA	+220-volt rectifier.
V606	6336A	+220-volt control tube.
V607	6336A	+220-volt control tube.
V608	5R4WGA	+220-volt rectifier.
V609	6AU6WA	+220-volt amplifier.
V610	5R4WGA	−220-volt rectifier.
V611	6080WA	−220-volt control tube.
V612	6AU6WA	−220-volt amplifier.
V613	0B2WA	Voltage regulator.
V614	5R4WGA	+220-volt rectifier.
V615	5933	+440-volt control tube.

82. Transmitter Compartment Tube Replacement

a. General. Loosen the 10 knurled thumbscrews on the transmitter compartment door. Grasping both handles, pull out about one inch to engage the hinges, and then open the door with the handle on the left-hand side. Remove the caps from the modulator-transmitter tubes before pulling the tubes out. The trigger amplifier chassis is mounted on the left-hand side of the compartment.

Note. Voltage adjustments must be made when thyratron switch tube V1104 is replaced. Refer to paragraph 95 for these adjustments.

Warning: Be sure that the high voltage is off before replacing any transmitter tubes. Bleeder resistors in the circuit serve to dissipate any energy stored in high-voltage capacitor C1101 or in the charging network. For further assurance that no high voltage remains on any component capable of storing energy, a shorting rod is provided for discharge purposes. Remove the shorting rod from its clamped position across the front of the transmitter compartment and discharge both terminals of C1101; the caps and mounting plates of V1101, V1102, V1103, and V1106; and the cap of V1104.

b. Tube Complement for Modulation-Transmitter (fig. 62).

Symbol	Tube type	Function
V1101	577	High-voltage rectifier.
V1102	577	High-voltage rectifier.
V1103	577	Reverse current diode.
V1104	5949A	Thyratron switch tube.
V1105	QK324	Magnetron transmitter.
V1106	577	Charging diode.

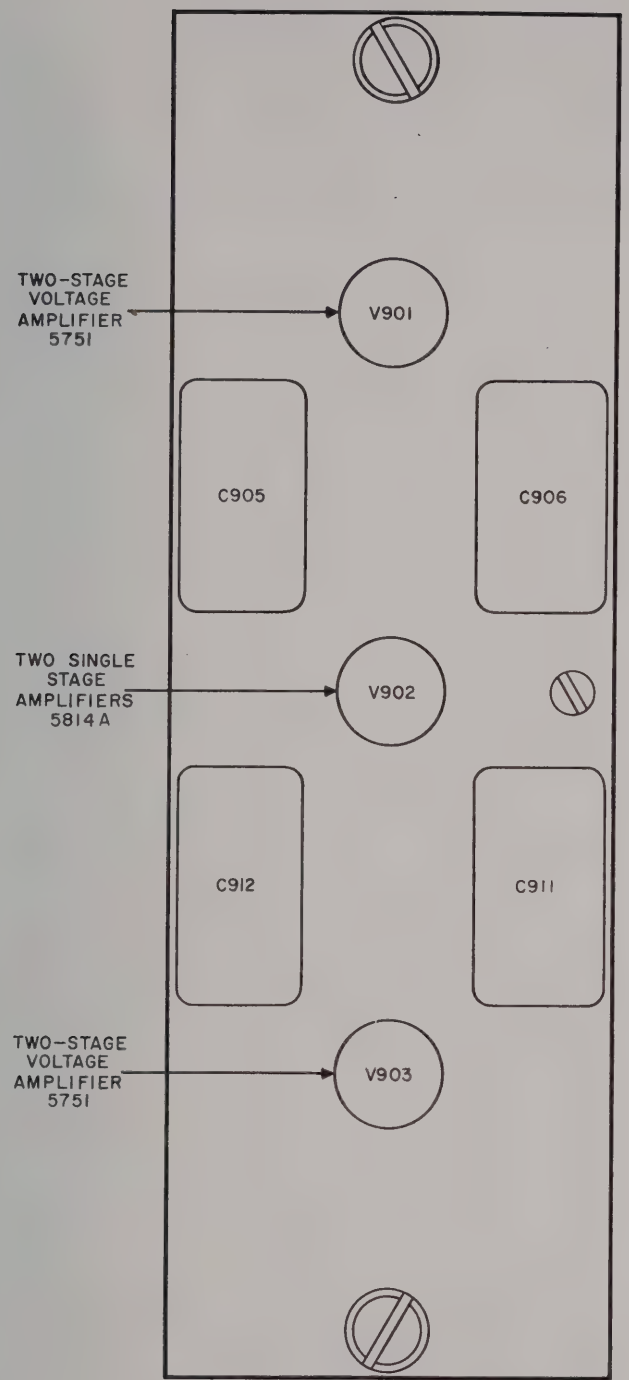


Figure 57. Isolation amplifier chassis, tube location diagram.

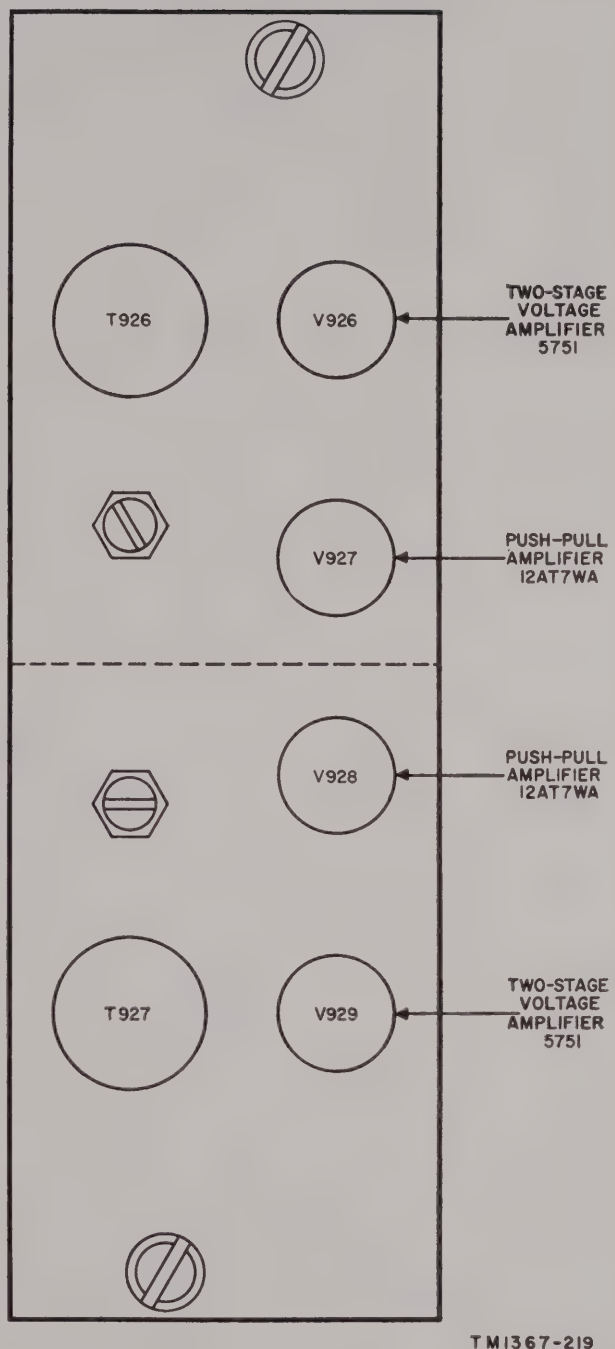


Figure 58. Servo amplifier chassis, tube location diagram.

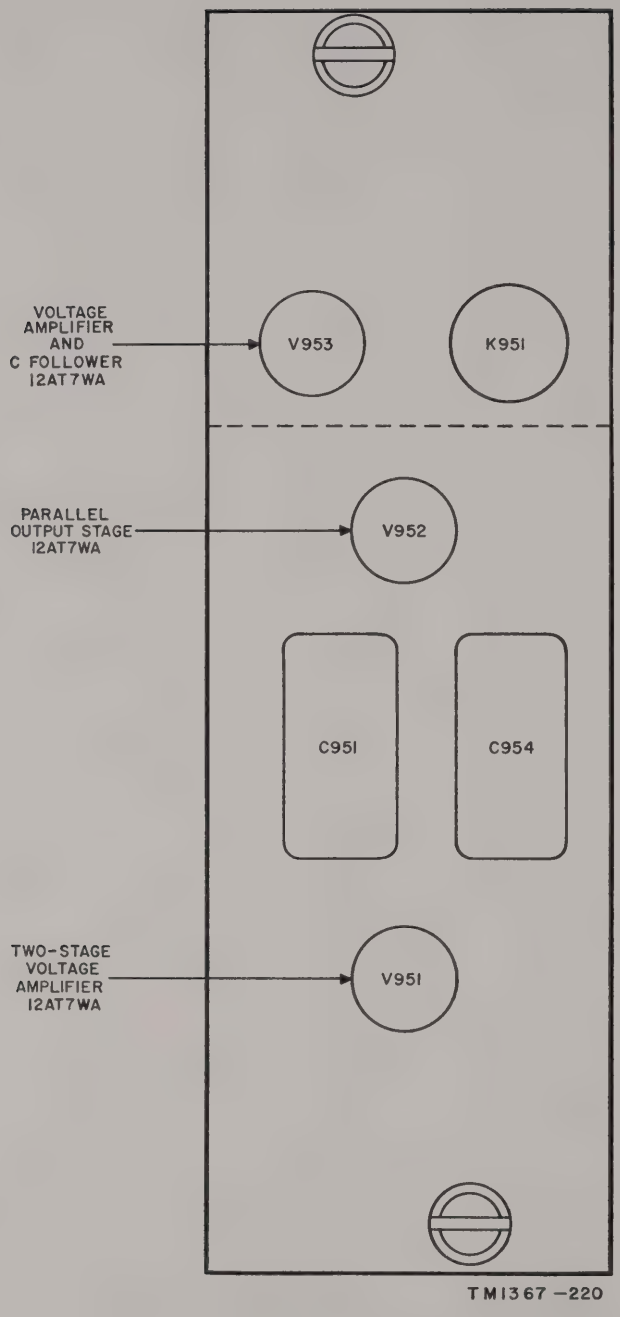


Figure 59. Booster and dual speed cutover amplifier chassis, tube location diagram.

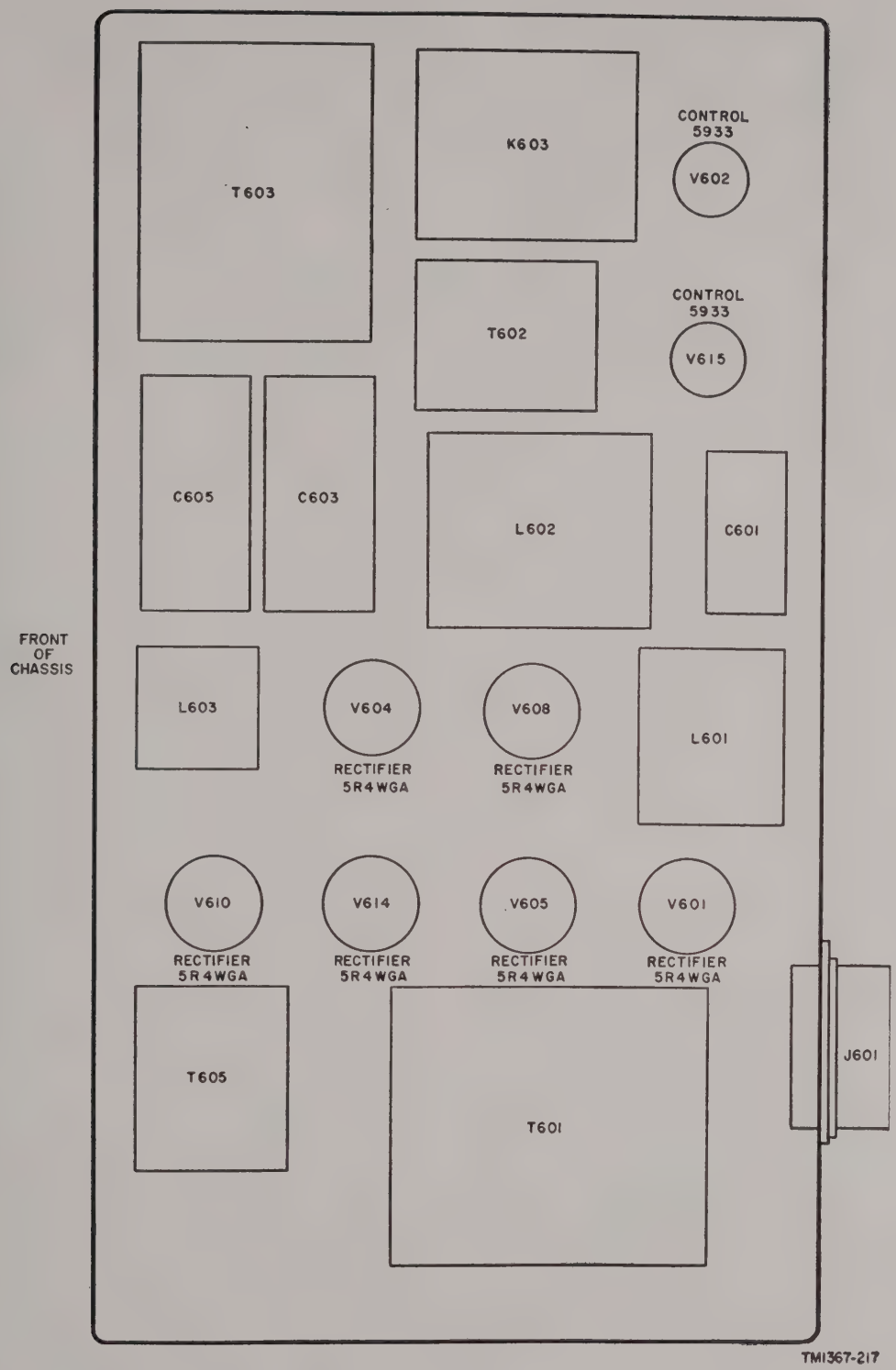


Figure 60. Control-power supply, right-hand side, tube location diagram.

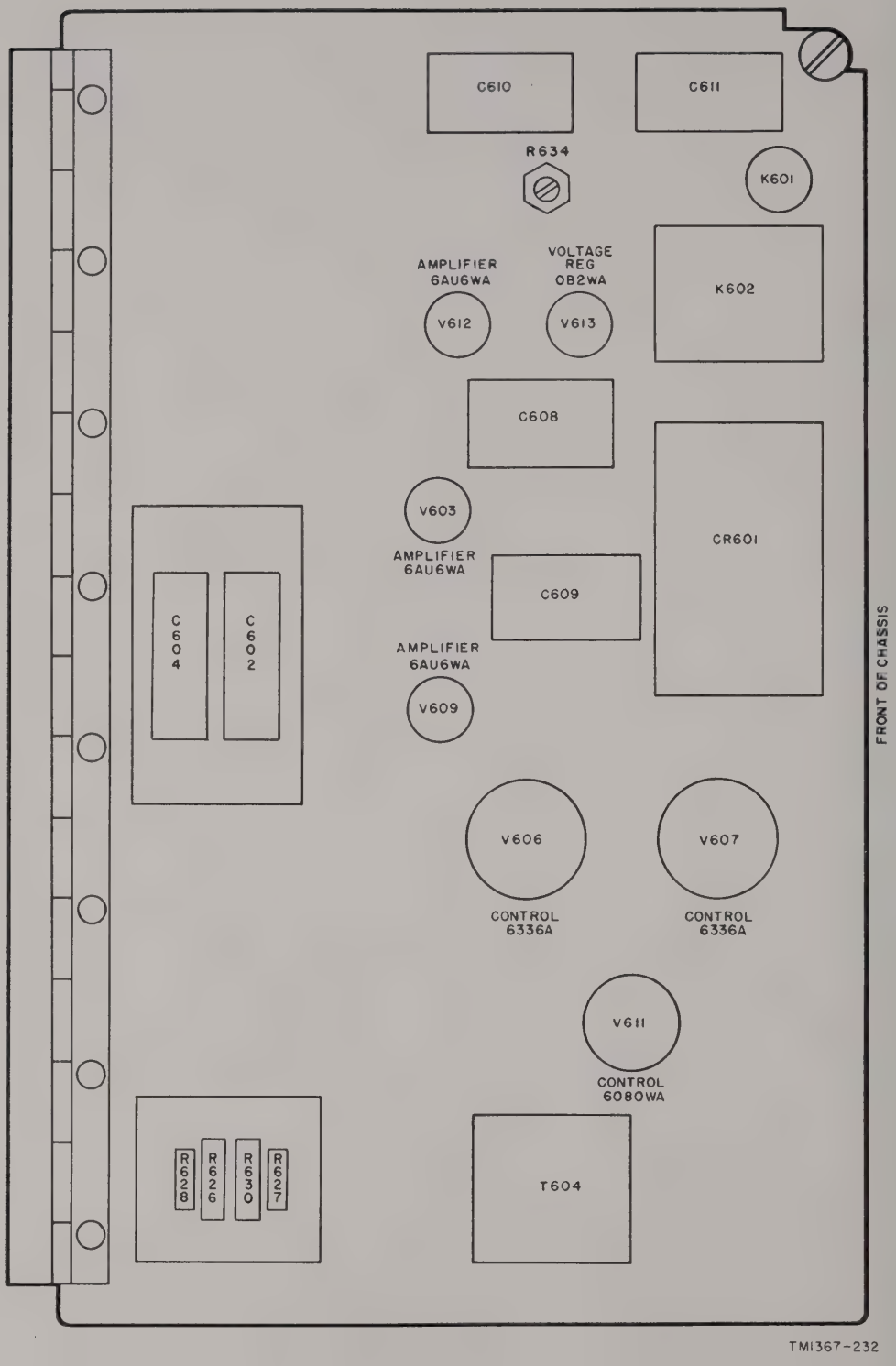


Figure 61. Control-power supply, left-hand side, tube location diagram.

c. Tube Complement for Trigger Amplifier (fig. 63).

Symbol	Tube type	Function
V1151A	5687	Cathode follower.
V1151B	----------	Blocking oscillator.
V1152A	5687	Blocking oscillator.
V1152B	----------	Cathode follower.
V1153	6130	Thyratron switch.
V1154	5R4WGA	Charging diode and reverse current diode.
V1155	5R4WGA	Rectifier.

d. Replacement of Magnetron Tube V1105. The magnetron tube is located in the upper left-hand corner of the transmitter compartment (fig. 62).

Warning: High voltage must be off before the magnetron tube is removed.

(1) Loosen the two nuts that connect the magnetron filament leads to pulse transformer T1106 (fig. 62), and disengage the leads.
(2) Disconnect one end of waveguide W1102 by removing the four screws that secure it to the magnetron.
(3) Disconnect one end of flexible waveguide W1101 by removing the four screws that secure it to W1103. Be careful not to damage this waveguide or leakage will result. Place the two sections of the waveguide aside.
(4) At the rear of the magnetron, slide the rubber coupling from the cooling fins back over the air duct.
(5) Remove the two wingnuts and bolts which support the magnetron in position.
(6) Carefully remove the tube from its socket.
(7) Insert the new tube in the socket and lock it in securely.
(8) Replace the two wingnuts and bolts.
(9) Reconnect the magnetron filament leads to pulse transformer T1106.
(10) Reconnect W1102 to the magnetron.
(11) Reconnect W1101 to W1103.
(12) Reconnect the rubber coupling at the rear of the magnetron.
(13) With the power on, adjust the MAGNETRON POWER variac until the MAGNETRON CURRENT meter reads 22 ma.

83. Receiver Compartment Tube Replacement

a. General. Loosen the six knurled thumbscrews on the receiver compartment door. Grasp both handles and pull out to engage the hinges; then open the door with the handle on the right-hand side. Reading from left to right, the three chassis mounted on the floor of the compartment, are the afc assembly, IF amplifier, and stc assembly (fig. 67).

b. Tube Complement for IF Amplifier (fig. 64). To gain access to all IF tubes, slide the IF amplifier forward. Disconnect the three cables from J1201, J1202, and J1204. Loosen the screws from the front flange of the chassis and slide the chassis out until all tubes can be easily reached.

Symbol	Tube type	Function
V1201	5842	Low-noise amplifier.
V1202	5842	Grounded grid amplifier.
V1203	5654/6AK5W	IF amplifier.
V1204	5654/6AK5W	IF amplifier.
V1205	5654/6AK5W	IF amplifier.
V1206	5654/6AK5W	IF amplifier.
V1207	5654/6AK5W	IF amplifier.
V1208	5655/6AK5W	IF amplifier.
V1209	5654/6AK5W	IF amplifier.
V1210	6AU6WA	Video amplifier.
V1211	6AH6	Cathode follower.

c. Tube Complement for Afc Assembly fig. 65).

Symbol	Tube type	Function
V1301	5654/6AK5W	IF amplifier.
V1302	5654/6AK5W	Range calibration output.
V1303	5654/6AK5W	IF amplifier.
V1304	5726/6AL5W	Discriminator.
V1305	6AU6WA	Pulse amplifier.
V1306	5749/6BA6W	Afc output.
V1307	6AU6WA	Oscillator.
V1308	5726/6AL5W	Pulse stretcher.

d. Tube Complement for Stc Assembly (fig. 66).

Symbol	Tube type	Function
V4701	5687	Pulse amplifier.
V4702	5814A	Sensitivity time control.

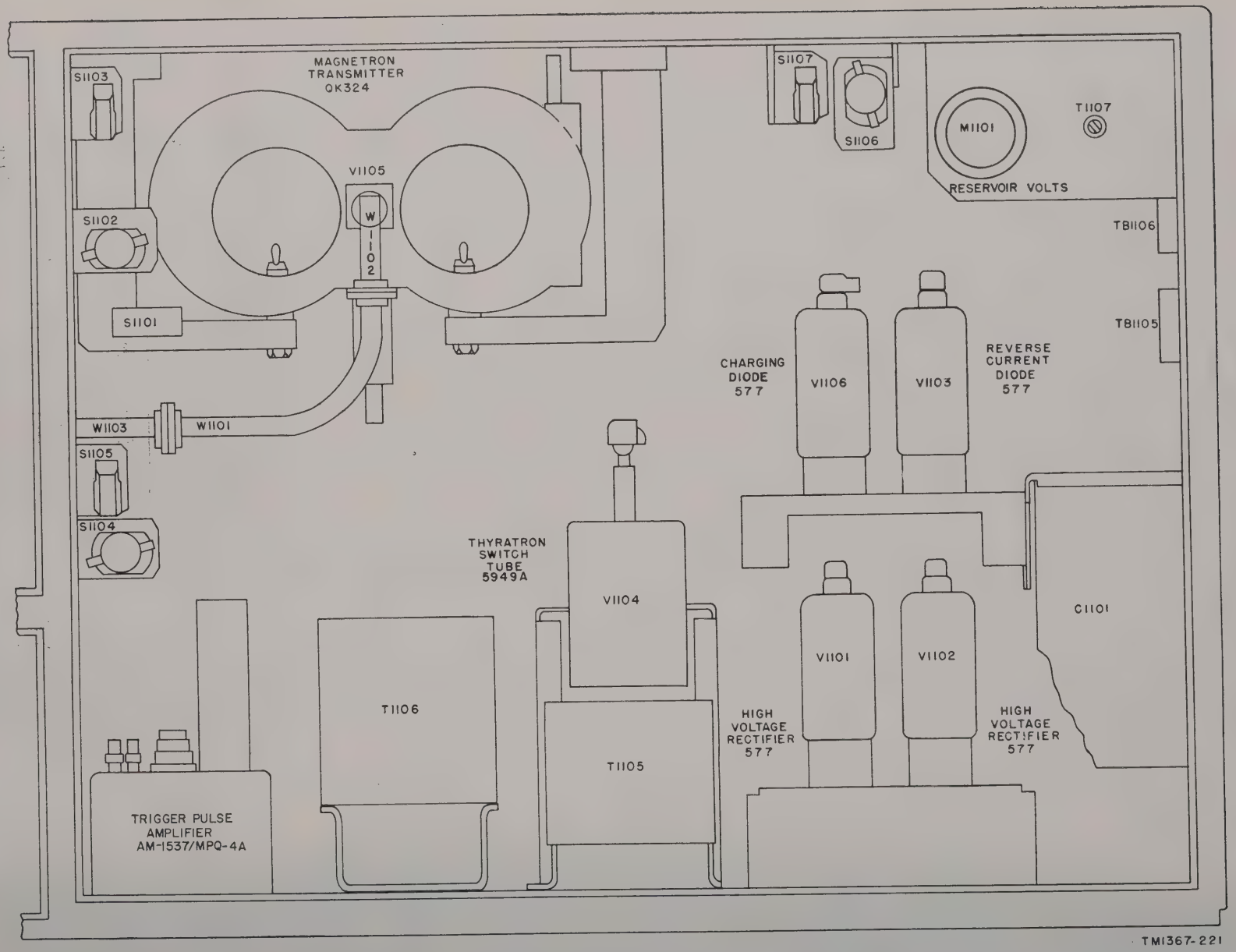


Figure 62. Transmitter compartment, tube location diagram.

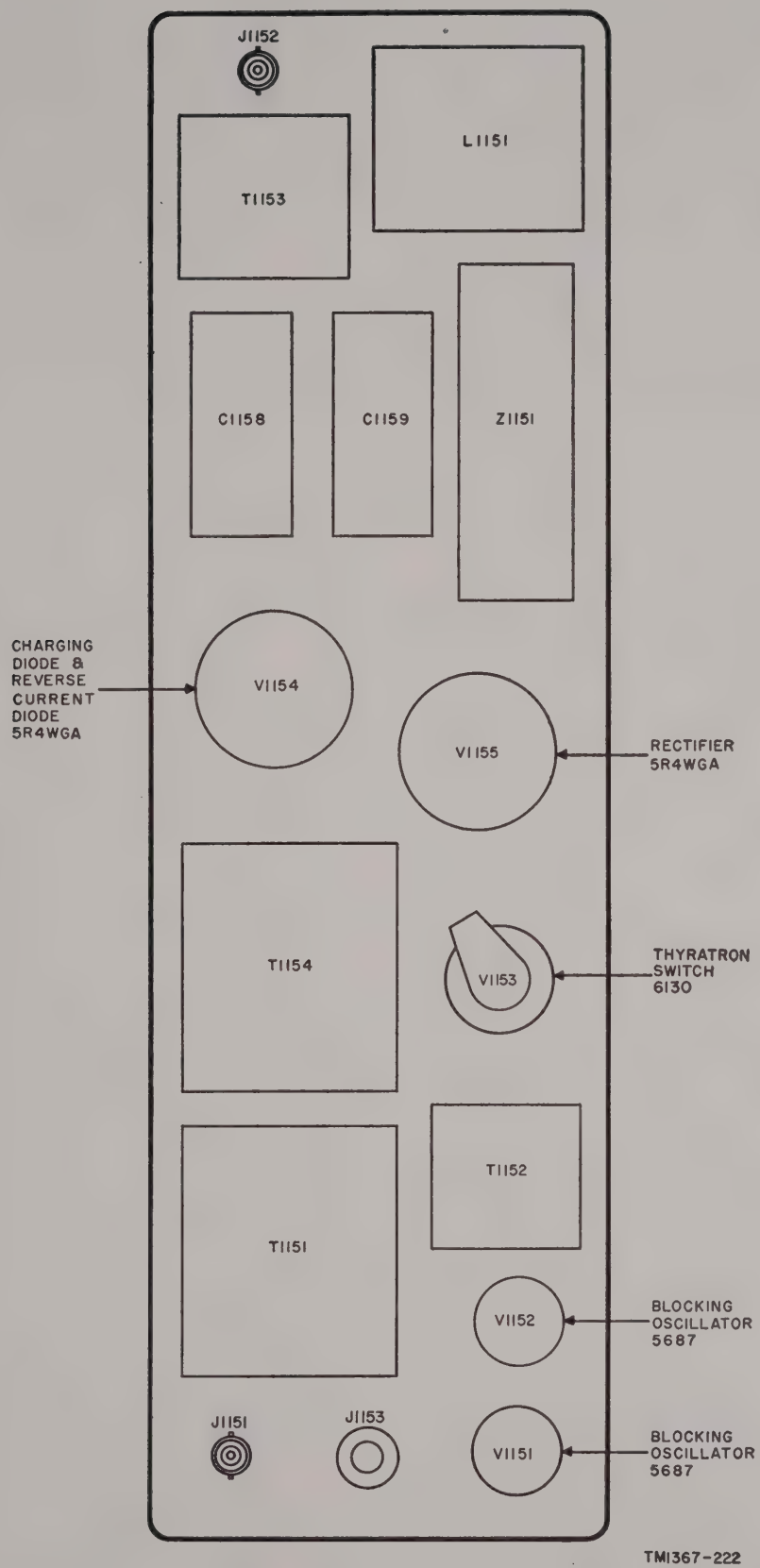


Figure 63. Trigger amplifier, tube location diagram.

e. Replacement of Klystron Tube V1501 (figs. 67 and 68). To replace the klystron tube remove the duplexer and klystron motor assembly.

(1) Disconnect P1503, P1501, and P1502 from the duplexer crystals (fig. 67).
(2) Disconnect the two leads from the tube caps on the TR tube assembly.
(3) Disconnect P1504 on the cable coming from TB1501.
(4) Remove the four screws and O-ring from the flange that connects waveguide W1510 to the magnetron waveguide.
(5) Remove the four screws and O-ring from the flange that connects waveguide W1512 to the rear of the cabinet.
(6) Remove the four knurled thumbscrews from the duplexer mounting plate on the inside top of the compartment.
(7) Slide the duplexer and klystron motor assembly forward and remove from cabinet. Place it on a clean, level surface to remove the klystron tube.

Note. Do not disturb the position of the klystron tuning shaft when removing the tube.

(8) Disconnect the klystron tube plug P1506 from its socket (fig. 68).
(9) Push the actuator side of the klystron coupling against the coupling spring and rotate clockwise so that the pin slides into its locking position (fig. 68).
(10) Remove the four phillips-head screws which secure the klystron tube to the waveguide, and remove the tube.
(11) Rotate the klystron tube coupling clockwise; carefully count the number of turns necessary to bring the tuning screw to its stop.
(12) Turn the tuning screw on the new klystron tube to its clockwise stop.
(13) Note the orientation of the coupling on the old klystron. Loosen the allen-head screw which holds the coupling to the old tube. Remove the coupling and transfer it to the new tube *in the same* orientation. Tighten the allen-head screw, and rotate the coupling counterclockwise for the same number of turns ((11) above).
(14) Secure the new tube to the waveguide with the four phillips-head screws ((10) above).
(15) Couple the kystron drive together by rotating the actuator side of the coupling counterclockwise until the pin slides from its detent position. The subsequent spring action on the actuator side will bring the two parts together. It may be necessary to rotate the klystron tuning screw slightly to allow the two coupling sections to mate securely.
(16) Reconnect the klystron tube plug P1506 to its socket.
(17) Reposition the duplexer and klystron motor assembly in the cabinet and secure it to the top of the compartment with the four knurled thumbscrews.
(18) Replace the four screws and O-ring on the flange that connects to waveguide W1512.
(19) Replace the four screws and the O-ring on the flange connecting to waveguide W1510.
(20) Reconnect P1504 and reconnect the leads to the TR tube caps.
(21) Reconnect P1502, P1501, and P1503 to the duplexer crystals.
(22) Replacement of the klystron tube necessitates realinement of the klystron drive assembly. Refer to paragraph 108 for these adjustments.

f. Replacement of TR Tube Assembly V1502 (fig. 68). To replace the TR tube assembly, remove the duplexer and klystron motor assembly.

(1) Repeat the procedures in *e*(1) through (7) above.
(2) Loosen the four roundhead screws (fig. 68).
(3) Remove the eight knurled screws that fasten the flanges of the TR tube to the duplexer.
(4) Slide the TR tube clear of the duplexer. Do not lose the figure-eight gasket.

(5) Replace the new TR tube with the tube caps up and the arrow pointing toward the high power section of the duplexer (fig. 68).

(6) Replace the eight screws in the TR tube flanges.

(7) Tighten the four roundhead screws ((2) above).

(8) Reposition the duplexer and klystron motor assembly in the cabinet and secure it to the top of the compartment with the four knurled thumbscrews.

(9) Replace the four screws and O-ring on the flange that connects to waveguide W1512.

(10) Replace the four screws and O-ring on the flange that connects to waveguide W1510.

(11) Reconnect P1504 and reconnect the leads to the TR tube caps.

(12) Reconnect P1502, P1501, and P1503 to the duplexer crystals.

84. Low-Voltage Power Supply Tube Replacement
(fig. 69)

a. General. To gain access to the low-voltage power supply tubes, loosen the four knurled thumbscrews on the front panel and pull out the drawer in the receiver-transmitter cabinet.

b. Tube Complement.

Symbol	Tube type	Function
V1601	0B2WA	Voltage reference.
V1602	5R4WGA	+580-volt rectifier.
V1603	5R4WGA	+260-volt rectifier.
V1604	5R4WGA	+260-volt rectifier.
V1605	5R4WGA	+450-volt rectifier.
V1606	5933	+300-volt regulator.
V1607	6080WA	+150-volt regulator.
V1608	6080WA	+150-volt regulator.
V1609	5933	−300-volt regulator.
V1610	6AU6WA	+300-volt amplifier.
V1611	6AU6WA	+150-volt amplifier.
V1612	6AU6WA	−300-volt amplifier.

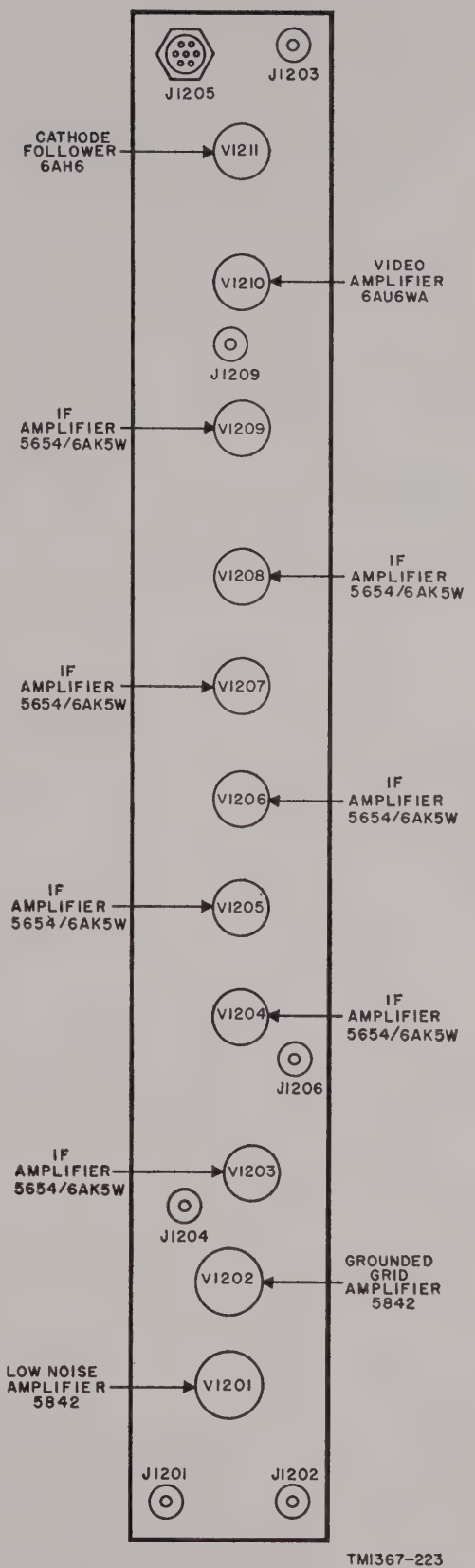


Figure 64. IF amplifier, tube location diagram.

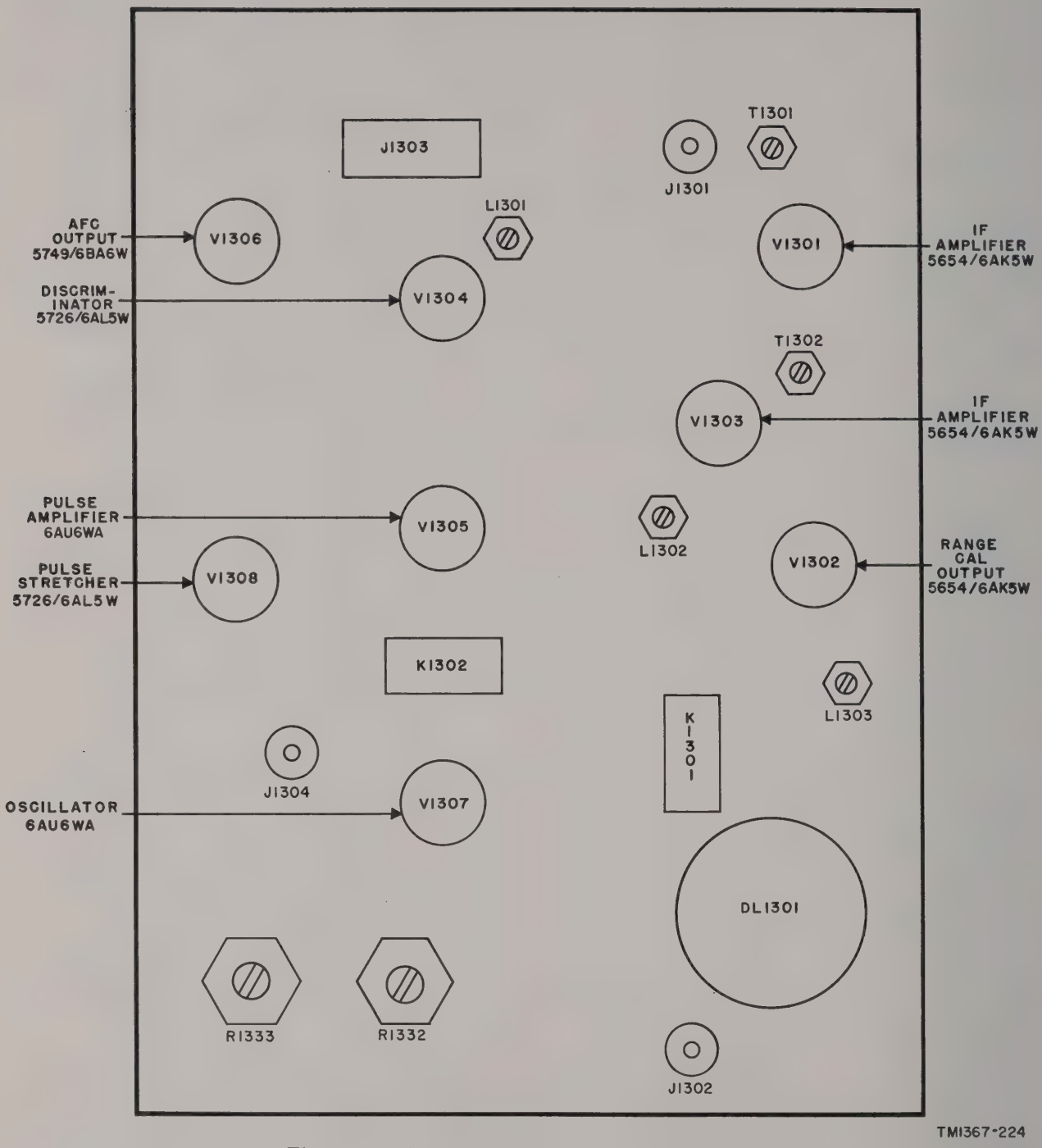


Figure 65. Afc assembly, tube location diagram.

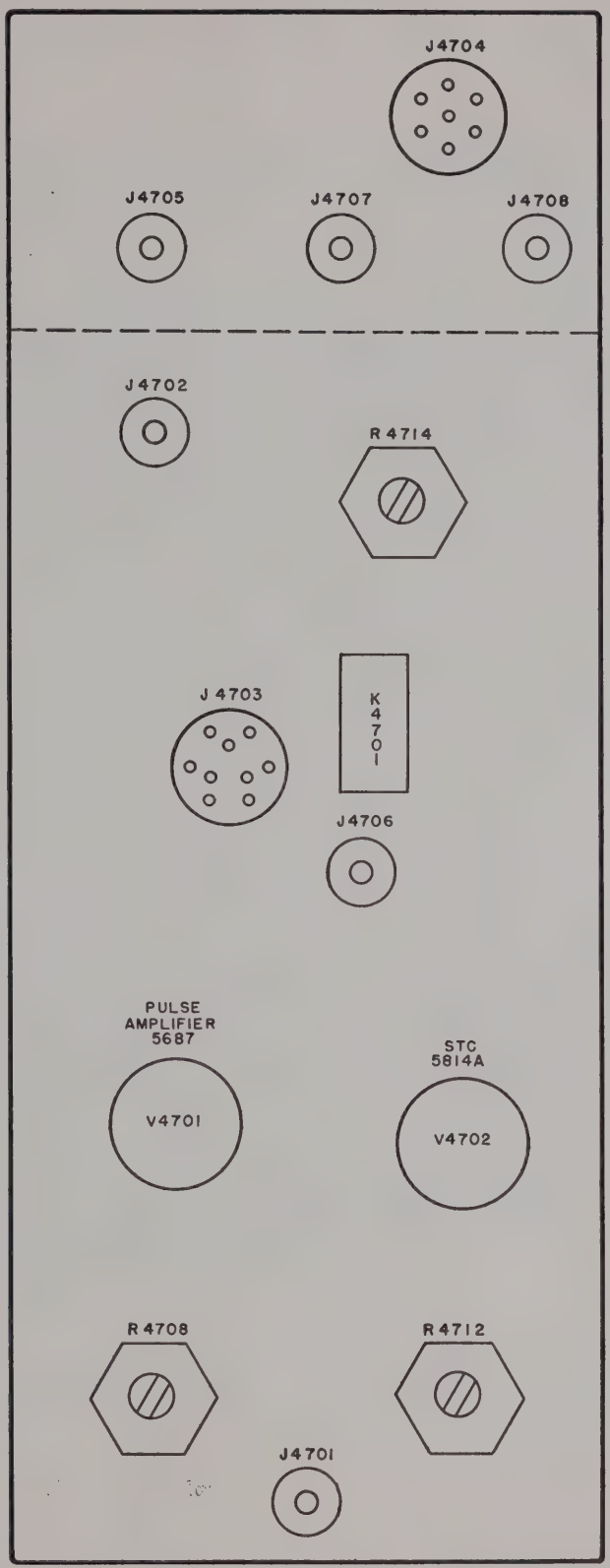


Figure 66. Stc assembly, tube location diagram.

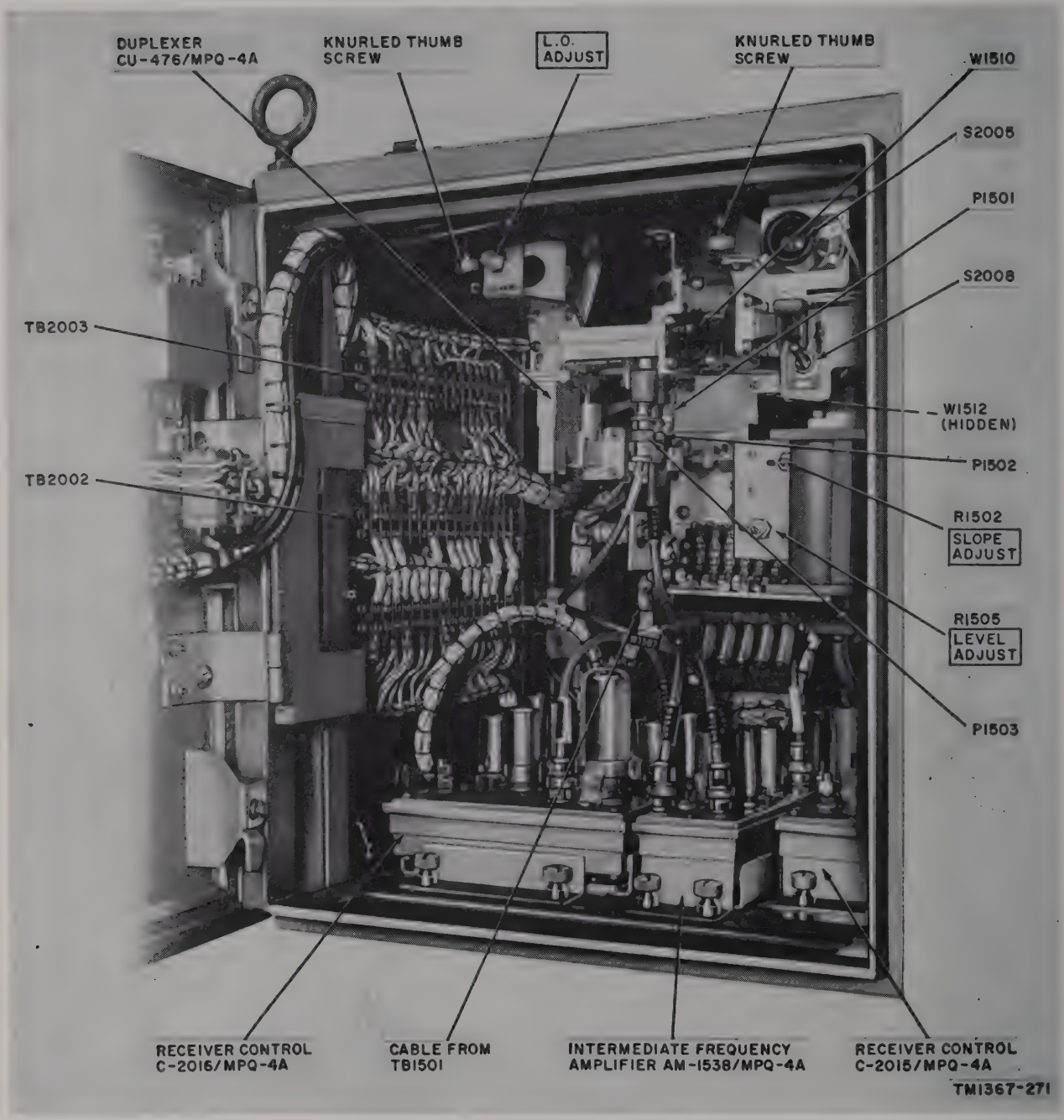


Figure 67. Receiver compartment, location of duplexer and klystron motor assembly.

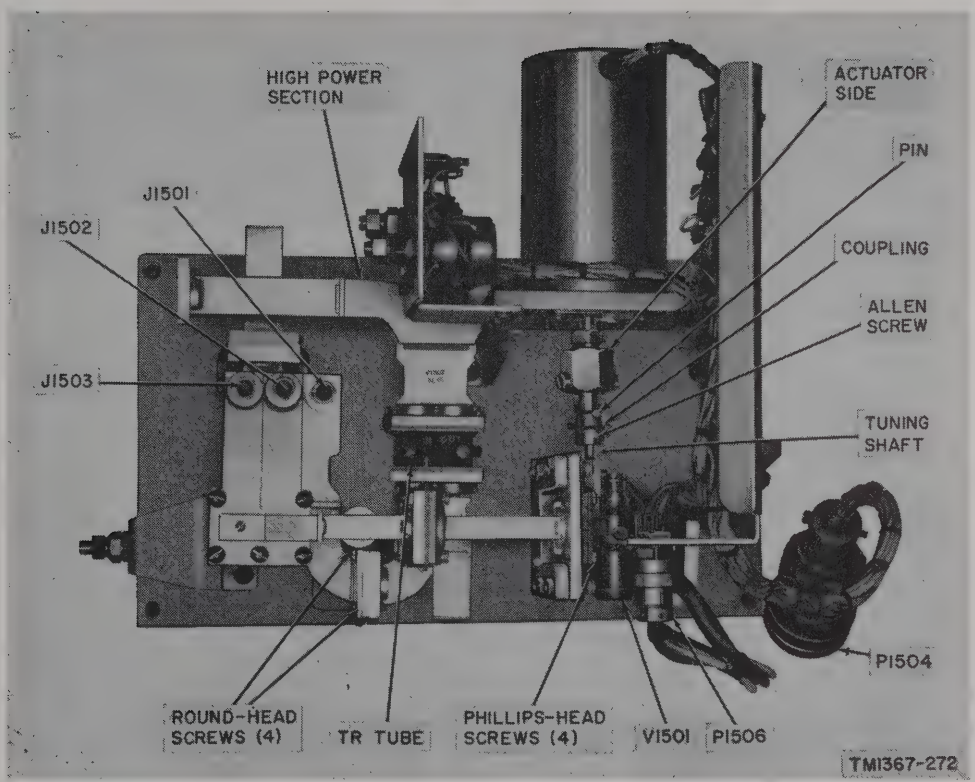


Figure 68. Duplexer and klystron motor assembly removed from cabinet, top view.

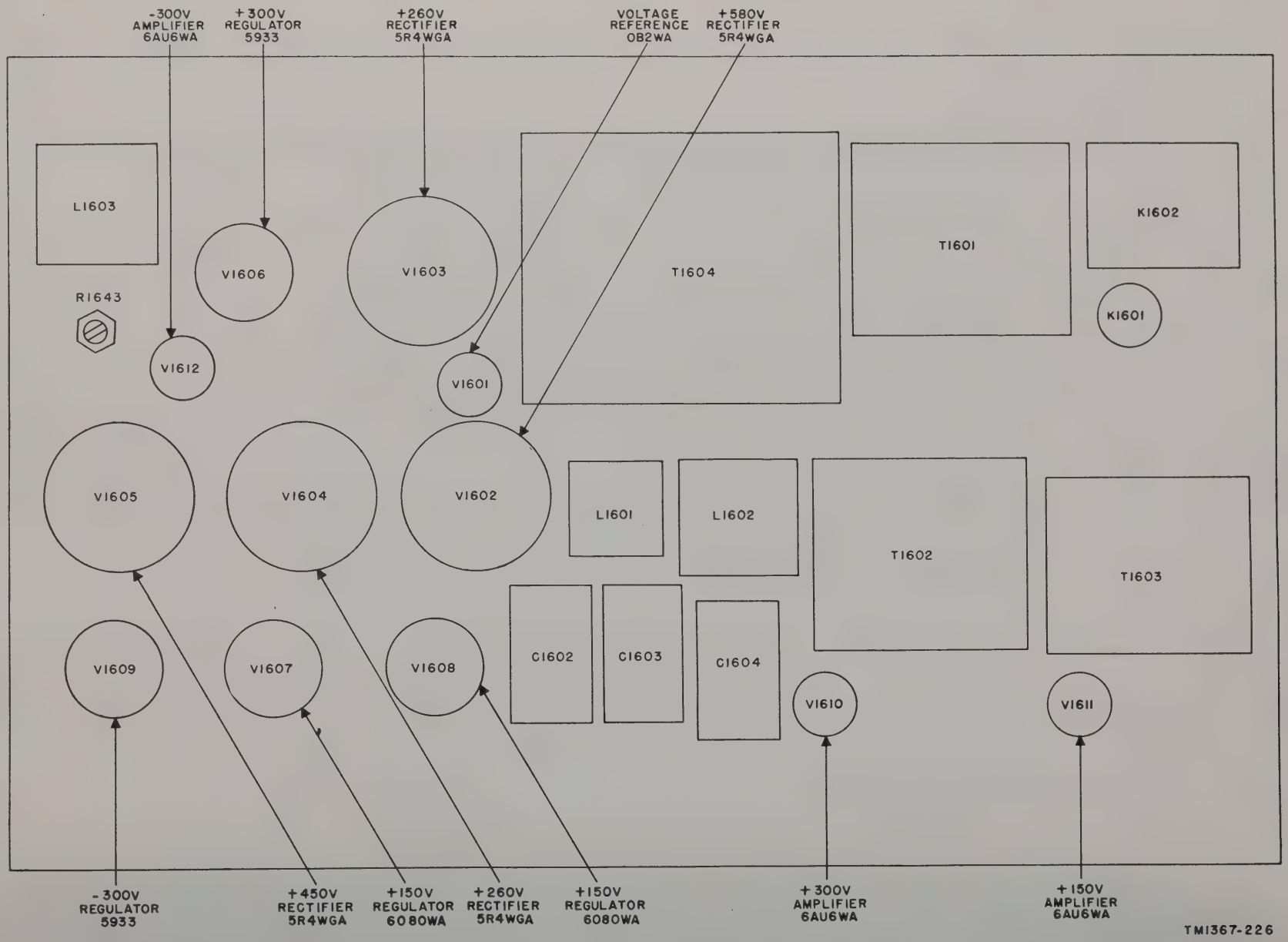


Figure 69. Low-voltage power supply, tube location diagram.

85. Replacement of Crystals

a. Replacing Crystals in Duplexer. There are three crystals mounted on the duplexer in the receiver compartment (fig. 67). Refer to the crystal complement in *c* below.

(1) To replace crystal CR1502 or CR1503, unscrew the knurled jack fitting J1502 or J1503 (fig. 68) and pull the crystal from its socket. Insert a new crystal and replace the fitting.

(2) To replace crystal CR1501, unscrew the knurled dummy plug on the side of the duplexer directly opposite J1501, and pull out the crystal. Insert a new crystal and replace the dummy plug.

b. Replacing Crystal in Echo Box (fig. 70).

(1) Remove the 10 allen-head screws from the front panel.

(2) Remove the four allen-head screws that secure the waveguide flange on the left side of the box.

(3) Remove the front panel. All circuit elements are mounted on the rear of the panel.

(4) Unscrew the knurled fitting on the crystal holder and remove the crystal.

(5) Insert a new crystal and replace the knurled fitting.

(6) Replace the front panel in the case and secure it with the 10 allen-head screws ((1) above).

(7) Replace the four allen-head screws that secure the waveguide flange on the left side of the box.

c. Crystal Complement.

Symbol	Crystal type	Function
CR1501	IN78A	Signal crystal No. 1.
CR1502	IN78A	Signal crystal No. 2.
CR1503	IN78A	Afc crystal.
CR1701	IN78	Meter rectifier crystal.

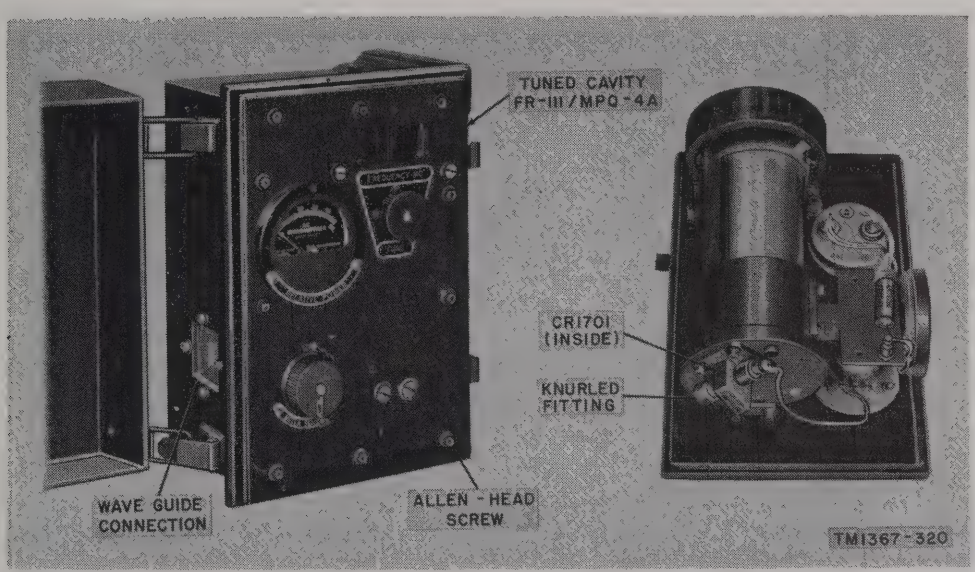


Figure 70. Echo box, crystal replacement.

86. Replacement of Relays

a. General. The relays listed in *b* below are running spares and may be replaced by the unit repairman. Relay K601 is located on the control-power supply (fig. 61); relay K1601 is on the low-voltage power supply (fig. 69). The five modulator transmitter relays are mounted on a small chassis (fig. 79) located on the rear of the transmitter door. To replace a relay, pull it from the socket and insert a new one.

Caution: Shut off all power to the radar set before removing relays.

b. Relay Complement.

Symbol	Location	Function
K601	Control-power supply.	30-second time-delay relay.
K1101	Transmitter door	Hv power supply overload relay.
K1102	Transmitter door	Reverse current overload relay.
K1103	Transmitter door	Cutout relay for magnetron filament power.
K1105	Transmitter door	Trigger amplifier overload relay.
K1106	Transmitter door	Magnetron surge current relay.
K1601	Low-voltage power supply.	30-second time-delay relay.

87. Desiccant Chamber Replacement

a. General. When the color of the dehydrator dry air indicator shows pink, the silica gel in the desiccant chambers is no longer active and the chambers should be replaced (*b* below). Do not remove the dehydrator from the trailer to perform this operation. If no spare chambers are available, refer to a higher echelon for repair. It is not possible to reactivate the desiccant chambers in the field.

b. Replacing Desiccant Chambers (fig. 71).

(1) Disconnect cable W710 from J3301 at the right rear of the cabinet as a safety precaution.

(2) Release the six latches which secure the top cover to the cabinet. Lay the cover aside.

(3) See that the color of the silica gel in the dry air indicator in the top of each desiccant chamber is also pink before replacing the chambers.

(4) Disconnect the inlet hose (fig. 71) from the inlet fitting on the first chamber; use one adjustable wrench to apply counter torque to the 90° elbow and another to unscrew the connector.

(5) Disconnect the interconnecting hose between the two chambers; use the same method described in (4) above. Lay the hose aside.

(6) Disconnect the outlet hose from the outlet fitting on the second chamber; use the same method described in (4) above.

(7) Loosen the two worm screws that secure two steel clamps on each chamber.

(8) Lift the chambers out of the cabinet.

(9) Remove the seals from the inlet and outlet fittings on the new desiccant chambers.

(10) Place the chambers in the cabinet inside the steel clamps, and orient the inlet and outlet fittings as shown in figure 71.

(11) Tighten the worm screws on the steel clamps.

(12) Reconnect the inlet hose to the inlet fitting on the first chamber; use one adjustable wrench to apply counter torque to the 90° elbow and another to tighten the inlet connector.

(13) Install the interconnecting hose between the outlet fitting on the first chamber and the inlet fitting on the second chamber; use the same method described in (11) above.

(14) Reconnect the outlet hose to the outlet fitting on the second chamber; use the same method described in (11) above.

(15) Inspect all fittings in the dehydrator and tighten any that may be loose.

(16) Replace the cover on the cabinet and secure it with the six latches.

(17) Reconnect cable W710 to J3301 at the right rear of the cabinet.

Note. After the desiccant chambers are installed and the dehydrator is again operating, the color of the silica gel in the dry air indicator will gradually turn from pink to blue. This occurs as the dry air indicator releases its moisture to the dry air supplied from the desiccant chambers.

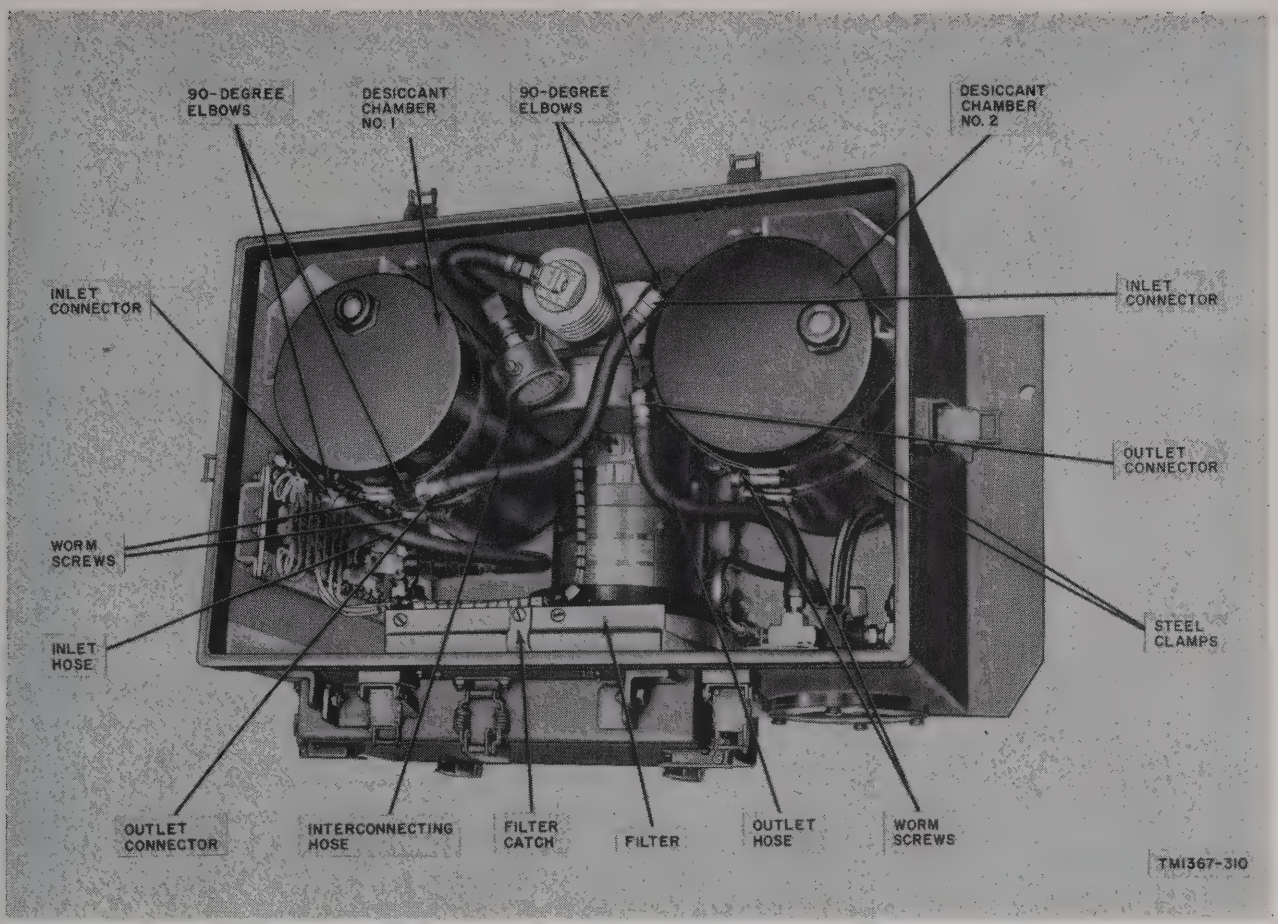


Figure 71. Dehydrator, cover removed, top view.

88. Checking Interlock Circuits

a. General. The interlock circuits in the radar set are designed to disconnect the high power circuits to prevent injury to personnel or damage to the equipment. Power is removed when any drawer or front panel is opened, or when the blower panels are closed. Interlock shorting switches, which can be manually operated, are provided for use during emergency operator or troubleshooting. No shorting switches are provided for interlocks that insure proper operation of the equipment.

b. Interlocks Without Shorting Switches.

(1) Switch S1007 on the rear left wall and switch S1008 on the rear right wall of the control-indicator cabinet (fig. 72) remain open until the air intake and air exhaust panels are opened.

(2) Switch S1101 in the transmitter compartment (fig. 62) will open automatically and cut off power to the modulator when the air pressure in the waveguide falls.

(3) Switch S1108 on the rear wall of the transmitter compartment remains open until the air intake panel is opened.

(4) Switch S2003 on the left side wall and switch S2004 on the rear wall of the receiver compartment remain open until the two air exhaust panels are opened.

(5) Switch S3001 in the scanner will open and cut off drive motor B3201 when the scanner expands or contracts beyond the designed tolerances.

(6) Switch S3003 (curbside) and switch S3004 (roadside) on the trailer fenders remain open until the fenders are folded down to permit antenna rotation.

(7) Switch S3301 on the rear of the dehydrator front panel remains open until the air intake panel is opened and thus prevents the compressor motor from operating.

c. Interlocks with Shorting Switches.

Interlock	Shorting switch	Used for	Location
S1001	S1002	Control-power supply drawer.	Control - indicator cabinet (fig. 72).
S1003	S1004	Indicator	Control - indicator cabinet (fig. 72).
S1005	S1006	Computer	Control - indicator cabinet (fig. 72).
S1102	S1103	Modulator door	Transmitter compartment (fig. 62).
S1104	S1105	Modulator door (B+).	Transmitter compartment (fig. 62).
S1106	S1107	Modulator door (trigger amplifier power supply).	Transmitter compartment (fig. 62).
S2005	S2008	Control-monitor	Receiver compartment (fig. 67).
S2006	S2009	Low-voltage power supply drawer.	Low - voltage power supply (right front inside drawer).

d. Checking Interlocks in Control-Indicator Group.

Note. The following checks are made with the power off, unless otherwise indicated.

(1) Pull out the control-power supply drawer and locate TB601 (fig. 73). Connect Multimeter TS–352/U to terminal 8 on this board (fig. 74).

(2) Remove the 16 phillips-head screws that secure the panel over the terminal boards on the left side of the cabinet (fig. 73). Connect the meter to terminal 7 on TB1002 (fig. 74).

(3) Close shorting switch S1002 (fig. 72) and check for continuity through the interlock circuit. If meter indicates continuity, switches S1003, S1005, S1007, and S1008 are operative. Perform the procedure in (6) below. If there is no continuity perform the procedures in (4) and (5) below.

(4) Pull open the indicator drawer and close shorting switch S1004. Continuity indicates that S1003 is defective.

(5) Close the indicator drawer and pull out the computer drawer. Close shorting switch S1006. Continuity indicates that S1005 is defective. Close the computer drawer.

Note. If no continuity is indicated ((4) and (5) above), the trouble is in S1007 or S1008. These switches are inaccessible to the unit repairman and must be referred to a higher echelon.

(6) Disconnect the meter from the circuit and close the control-power supply drawer.

(7) Disconnect the wire from S1007 to terminal 7 at TB1002 and connect the meter in series between the wire and terminal 7. Set the meter to the 10-ampere scale. Turn the MAIN POWER switch to ON. If a current reading is not obtained, S1001 is inoperative.

e. Checking Interlocks in Receiver-Transmitter Group.

(1) Open the receiver compartment door and locate TB2003 (fig. 67). Connect one lead of Multimeter TS1352/U to terminal 6 or 7 on this board (A, fig. 75).

Warning: Before making measurements in the transmitter compartment, remove the shorting rod from its clamped position across the front of the compartment and discharge both terminals of C1101; the caps and mounting plates of V1101, V1102, V1103, and V1106; and the cap of V1104.

(2) Open the transmitter door and locate TB1105 (fig. 62). Connect the other lead of the meter to terminal 6 on this board.

(3) Close shorting switches S1105 and S2008 and check for continuity through this portion of the interlock circuit. If the meter indicates continuity, switches S2003, S2004, S2006, and S1108 are operative. Perform the procedure in (5) below. If there

is no continuity, perform the procedure in (4) below.

(4) Open the low-voltage power supply drawer and close shorting switch S2009. Continuity indicates that S2006 is defective.

Note. If continuity is not obtained ((4) above), the trouble is in S2003, S2004, or S1108. These switches are inaccessible to the unit repairman and must be referred to a higher echelon.

(5) Disconnect the meter from the two terminal boards and reconnect it to terminals 6 and 7 on TB1106 (B, fig. 75). Open shorting switch S1105 and turn the MAIN POWER switch to ON. Close shorting switch S1103. If meter indicates continuity, S1101 is operative. Turn the MAIN POWER switch to OFF.

(6) Disconnect the meter from terminal board TB1106 and close shorting switches S1105 and S1107 (fig. 62). Turn the MAIN POWER switch to ON. If the equipment operates with the door open and the interlocks shorted out, one or more of the door interlocks are defective.

(7) Turn the MAIN POWER switch to OFF and inspect the door interlocks for physical damage.

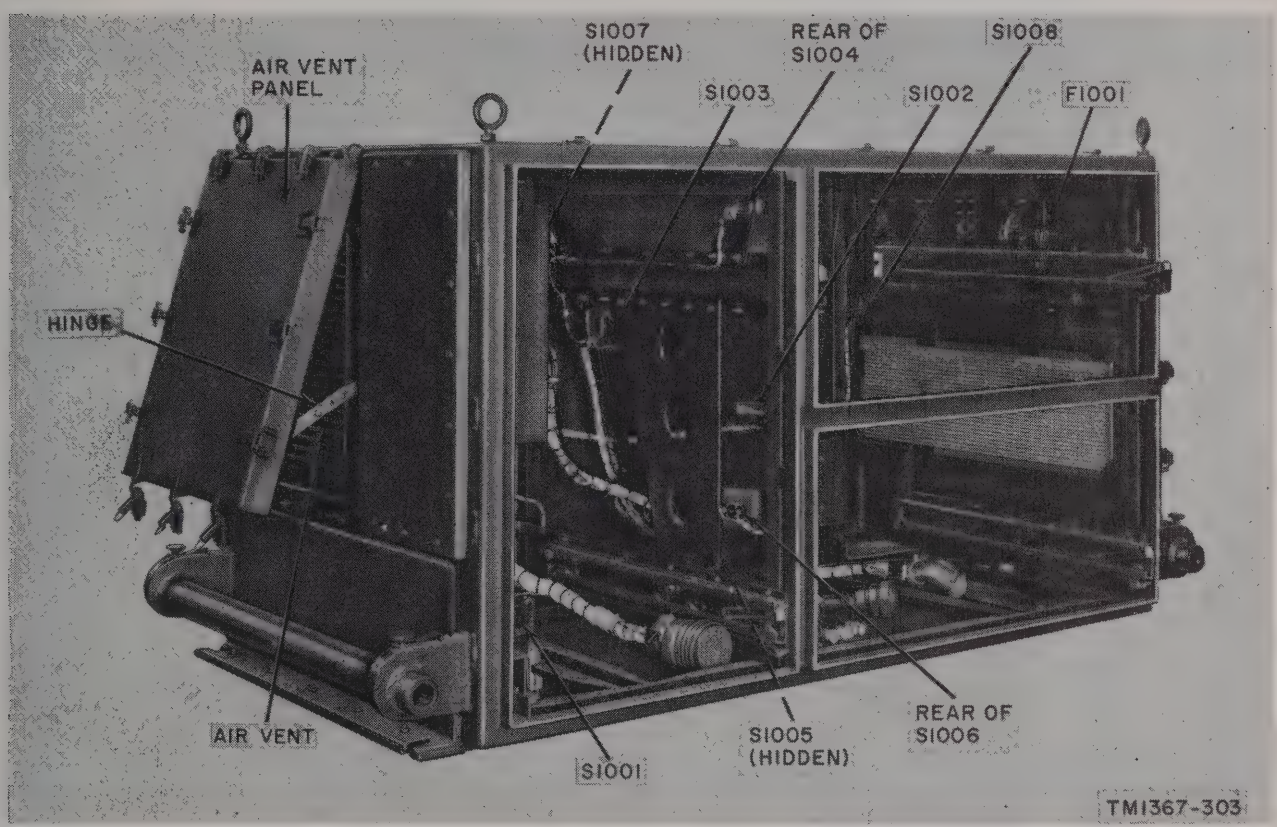


Figure 74. Interlock circuit for control-indicator group.

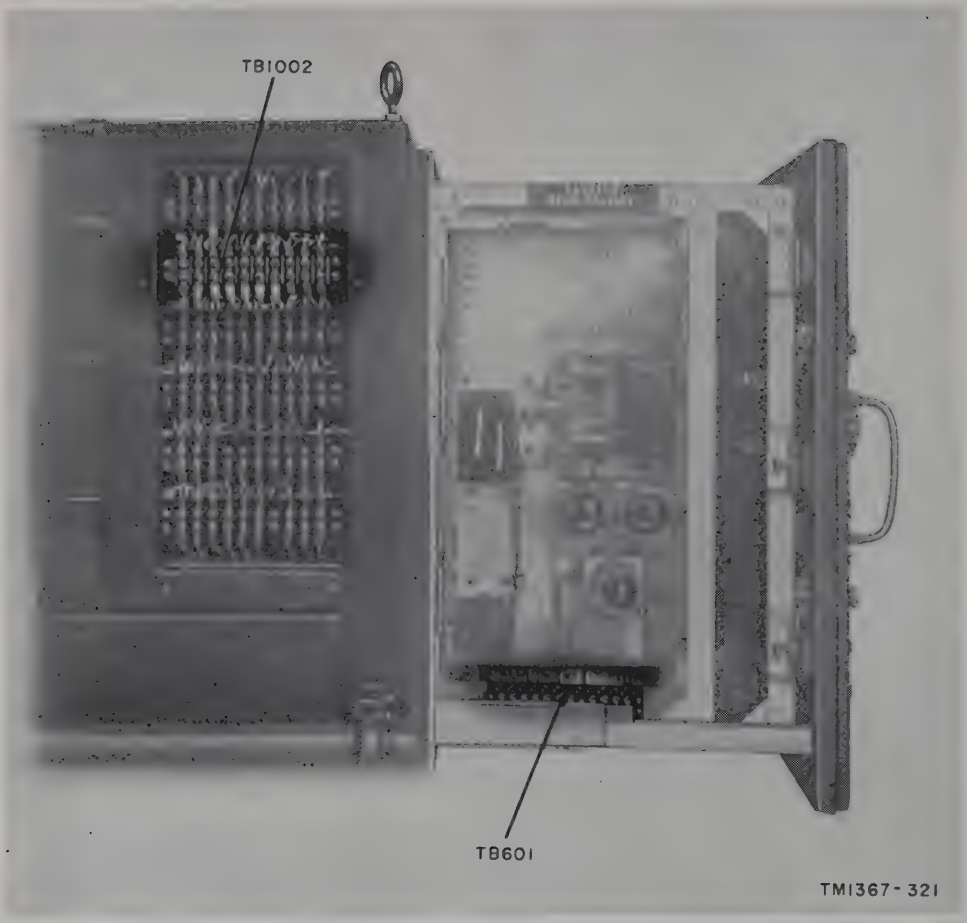


Figure 73. Control-indicator group, control-power supply drawer pulled out, partial left-side view.

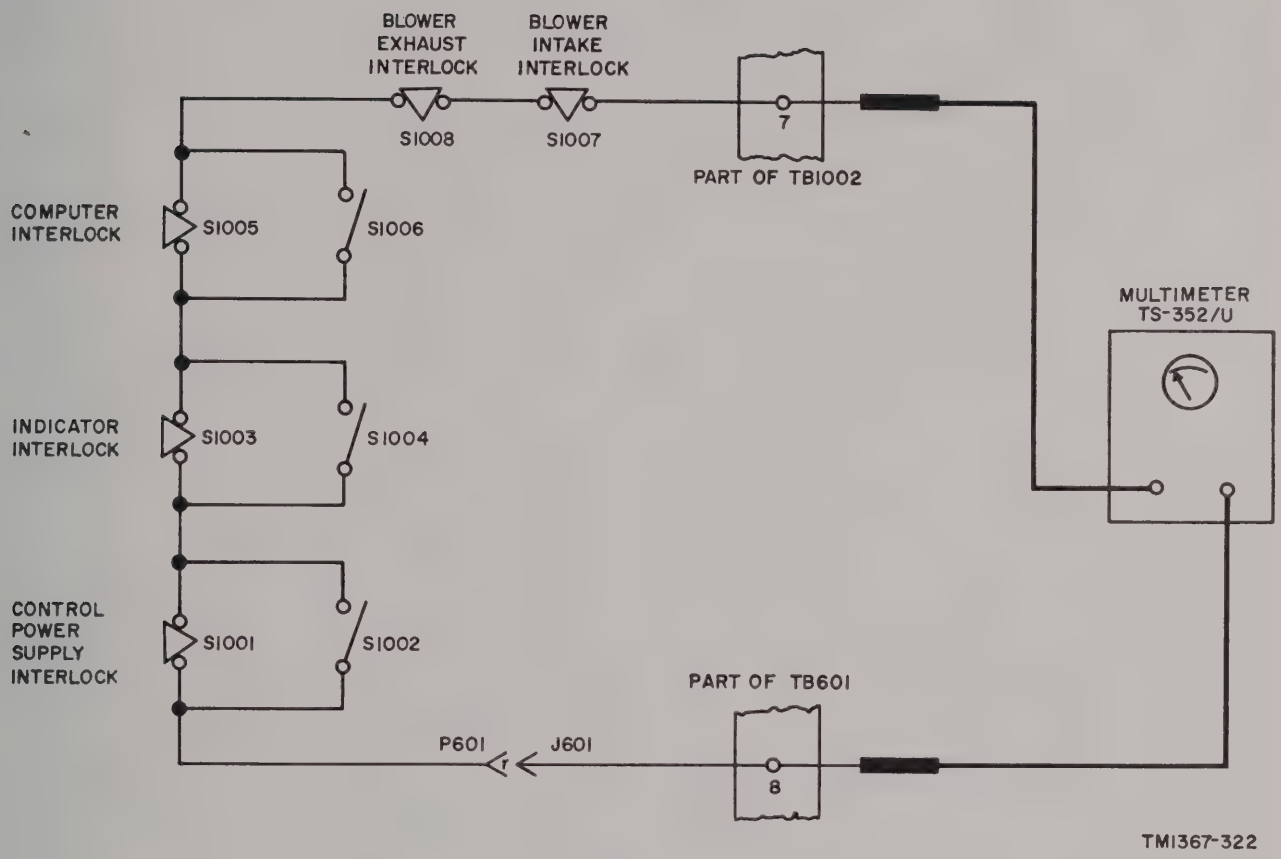


Figure 74. Interlock circuit for control-indicator group.

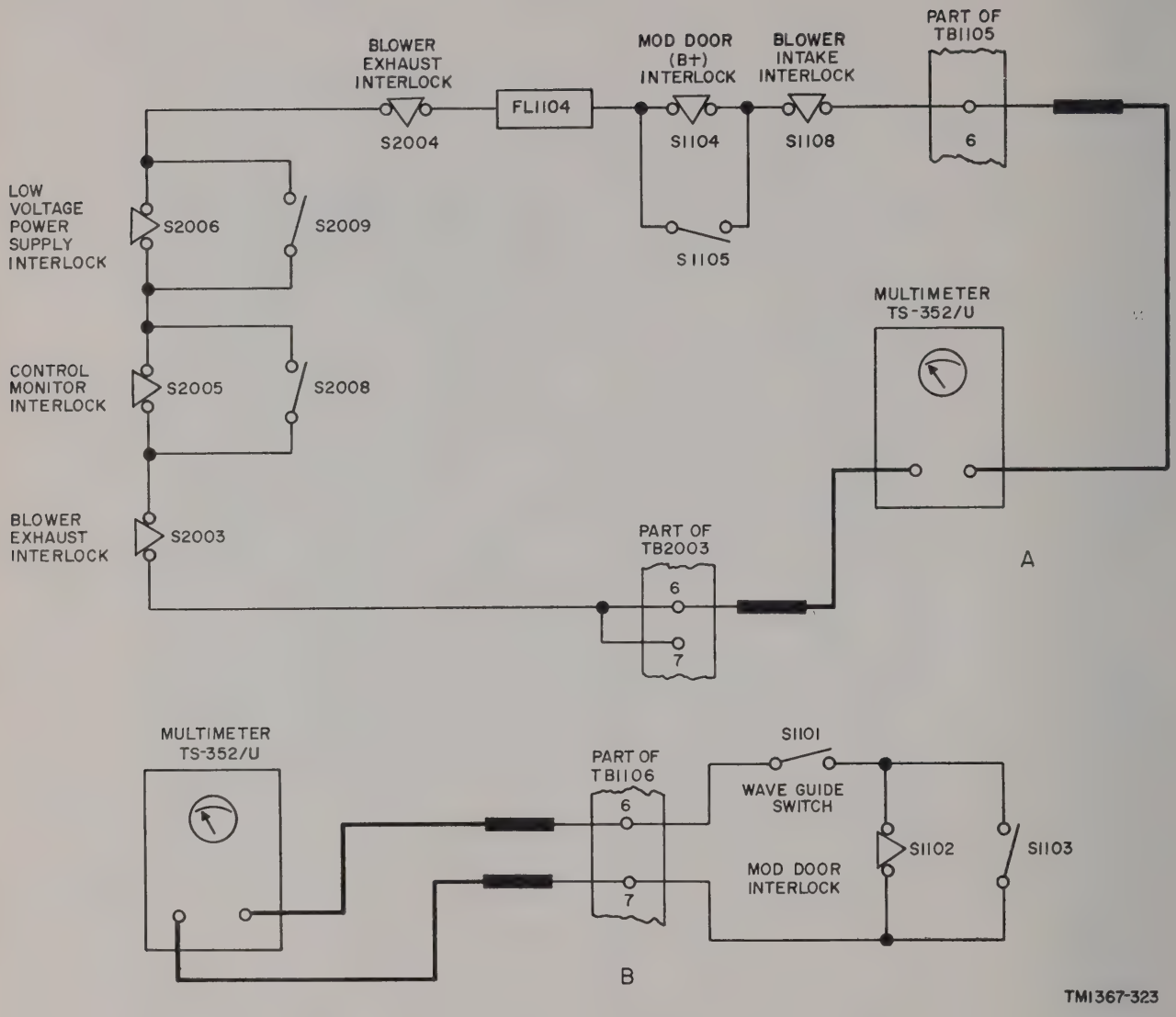


Figure 75. Interlock circuit for receiver-transmitter group.

89. Performing Waveform Checks

a. General. Waveform checks localize the trouble when the equipment is not operating properly. They are made with Oscilloscope AN/USM–32. For detailed operating instructions on the oscilloscope, refer to TM 11–5123. When obtaining waveforms, be careful to duplicate the conditions under which the normal waveforms are taken (*b* through *e* below). If an observed waveform does not closely resemble the normal waveform, trouble is indicated.

b. System Waveform Checks (fig. 81). Most of these waveforms can be checked at the indicator where test points are available on the top portions of the chassis. Otherwise, the waveform is obtained from a test jack or tube pin. Connect the oscilloscope between each check point and ground. A check point identified as V4601–7 indicates pin 7 of the tube V4601.

Check point	Fig. No.	Associated circuit	Sync	Oscilloscope sweep speed (μsec)
TP4573	52	Trigger input to transmitting and receiving systems	Signal	100
TP510	54	Az marker and start-stop pulses to synchronizing system	Signal	10,000
V4601–7	55	Video blanking input to indicating system	Signal	10,000
TP4554	52	Range step input to indicating system	Low ext from TP404	100
TP204	52	Long gate input to indicating system	Signal	100
TP4652	54	Short gate input to indicating system	Signal	100
TP404	53	Range mark input to indicating system	Signal	1.0
TP513	54	Az marker input to indicating system	Signal	1,000
TP504	54	Az gate input to indicating system	Signal	10,000
VIDEO TEST jack.	23	Video and range marker input to indicating system	Signal	10,000

c. Transmitter Waveform Checks (fig. 82). To obtain this waveform, connect the oscilloscope between the OUTPUT PULSE TEST jack on the control-monitor (fig. 23) and ground. The oscilloscope sweep speed is 10,000 μsec and the signal is used as sync. The input waveform to the trigger amplifier may be checked at TP4573 on the indicator.

d. Receiver Waveform Checks (fig. 84). Where the check point is a jack mounted on a chassis, disconnect the plug and connect the oscilloscope between the jack and ground. Use Test Prod MX–1604/USM–32 to check J1302. The table below lists the check point, associated circuit, and oscilloscope data for each waveform.

Check point	Fig. No.	Associated circuit	Sync	Oscilloscope sweep speed (μsec)
TP4573	52	Trigger input to stc assembly	Signal	100
J4702	66	Stc sawtooth input to IF amplifier	Signal	100
J1302	65	Range markers input to IF amplifier	Signal	1,000
VIDEO TEST jack.	23	IF amplifier output to indicator	Signal	10,000

e. Indicator Waveform Checks (figs. 87 and 88). The majority of these waveforms are checked at test points located on the top of each chassis. Where no test point is available, the waveform is obtained directly from the pin on the tube socket. To gain access to the tube sockets, swing out the appropriate panel. Connect the oscilloscope to the EXT TEST jack on the center top of the chassis (fig. 76), and use the test probe provided for the check points.

Check point	Fig. No.	Associated circuit	Sync	Oscilloscope sweep speed (μsec)
TP204	52	Long gate generator output	Signal	100
TP234	52	Timing sweep generator output	Signal	100
TP404	53	Range zero trigger pickoff output	Signal	1.0
TP404	53	Delay trigger pickoff output	Signal	1.0
TP404	53	Range marker trigger pickoff output	Signal	1.0
TP4573	52	Modulator trigger generator output	Signal	100
TP510	54	Azimuth synchronizer input	Signal	10,000
TP4572	52	Azimuth synchronizer output to modulator trigger generator	Signal	10,000
TP513	54	Azimuth synchronizer output to intensifier	Signal	1,000
TP504	54	Azimuth synchronizer output to azimuth sweep generator	Signal	10,000
TP4551	52	Video blanking input from azimuth synchronizer	Signal	10,000
V4601–7	55	Video blanking output to video amplifier	Signal	10,000
TP4554	52	Video blanking output to range sweep generator	Low ext from TP404	100
TP4552	52	Video blanking output to timer (lower beam)	Low ext	10,000
TP4553	52	Video blanking output to timer (upper beam)	Low ext	10,000
TP4402	55	Range sweep generator input from video blanking	Low ext	100
V4404–3	55	Range sweep generator output to CRT (negative vertical sweep)	Signal	100
V4405–3	55	Range sweep generator output to CRT (positive vertical sweep)	Signal	100
V4503–5	55	Azimuth sweep generator output to CRT (positive horizontal sweep).	Low ext	10,000
V4506–5	55	Azimuth sweep generator output to CRT (negative horizontal sweep).	Low ext	10,000
TP4652	54	Short gate generator output	Signal	100
TP4655	54	Intensifier output to pin 2 on CRT (long gate)	Signal	100
TP4655	54	Intensifier output to pin 2 on CRT (short gate)	Signal	100
TP4601	55	Video amplifier input from IF amplifier	Low ext from TP404	100
TP4604	55	Video amplifier output to CRT cathode	Low ext	100

Section III. ADJUSTMENTS

90. Indicator Adjustments (figs. 76 and 77)

The adjustments discussed in this paragraph with the exception of two adjustments on the front panel are found inside the indicator drawer. All of these controls have been preset at the factory and should ordinarily require no adjustment. Refer to paragraph 39 for alinement of the B-scope.

a. The REP. RATE adjustment (L201), located on the long gate generator (fig. 76), is used to set the repetition rate of the radar set. Inductor L201 has been adjusted for a count of 8,600 cps maximum and 8,500 cps minimum. The L201 tuning slug is locked and needs no adjustment.

b. The timing sweep generator has three adjustments: RANGE ZERO (R116) and RANGE SLOPE (R119) adjustments located on the front panel (fig. 25) and RANGE RATE adjustment (C232) located on the chassis (fig. 76). Capacitor C232 is used as a coarse adjustment for R119. These three controls are adjusted as follows:

(1) Turn the MARKERS switch to ON.

(2) Rotate the LOWER BEAM RANGE control on the computer until the RANGE counter reads 2,000 meters.

(3) Adjust the RANGE ZERO control until the range strobe line coincides with the 2,000-meter marker.

(4) Set the LOWER BEAM RANGE control for a reading of 8,000 meters.
(5) Adjust the RANGE SLOPE control until the range strobe line coincides with the 8,000-meter marker.
(6) If the alinement cannot be accomplished with this adjustment, return R119 to its midposition and adjust C232 until the strobe line and 8,000-meter marker coincide.
(7) Repeat the procedures in (2) through (5) above.

c. The AZIM. SYNCH GAIN adjustment (R547) is located on the azimuth synchronizer chassis (fig. 77). It is used to attenuate the synchronizing pulses fed into the azimuth synchronizer from the scanner. Turn R547 clockwise until the crt raster and the azimuth strobe line are unstable. Then turn R547 counterclockwise until the raster and strobe line are again unstable. Adjust R547 to an approximate midpoint between these two positions until a stable raster and strobe line are obtained. If there is another bright line on the left side of the raster, turn R547 slightly counterclockwise until the line disappears.

d. The intensifier and short gate chassis (fig. 77) has four adjustments. The SWP. SIZE ADJ (R4660) regulates the vertical size of the 2,500-meter band. With Oscilloscope AN/USM–32 (par. 89) connected between TP4652 and ground, adjust R4660 until a gate of 20 μsec is obtained. The SWP. INTEN. ADJ adjustment (R4657) sets the intensity of the intensified band. Set the brightness of the band slightly higher than the raster intensity. There are two H.F. COMP adjustments (C4658 and C4656). They are used to square up the corners on the intensifying gate. Adjust C4658 to sharpen the edges of the 2,500-meter intensified band. Adjust C4656 to sharpen the edges of the raster.

e. The azimuth sweep generator (fig. 76) has two adjustments: HOR. CENTERING (R4517) and HOR. SIZE (R4536). Adjust R4517 until the raster is horizontally centered. Adjust R4536 until the horizontal raster size just covers the CRT.

f. The VERTICAL CENTERING adjustment (R4409) is on the range sweep generator chassis (fig. 76). Adjust R4409 to set the raster to the center of the CRT.

g. The VIDEO CLIPPING adjustment (R4612) is on the video amplifier chassis (fig. 76). It is used to limit the video amplifier output during strong signals to avoid overdriving the CRT. With Oscilloscope AN/USM–32 connected between TP4604 and ground, adjust R4612 until the maximum video output signal is approximately 70 volts.

h. The RANGE SHIFT adjustment (R4560) is found on the video blanking chassis (fig. 76). It controls the amount of separation between the lower and upper beam presentations on the crt. With the RANGE SELECTOR switch at 10000 M, the RANGE SHIFT switch at ON, and the LOWER BEAM RANGE control set for a counter reading of 500 meters, adjust R4560 to separate the two beams by approximately one fourth-inch. With the RANGE SELECTOR switch at 2500M, adjust R4560 to separate the two beams by approximately 1 inch.

i. The H.V. ADJ adjustment (R164) is found on the bottom side of the indicator (fig. 77). It is mounted on a plate at the right rear of the assembly. The normal high-voltage reading is 14,000 volts. This is obtained at the near maximum setting of R164 and is not ordinarily measured or adjusted in the field.

j. VERT. SIZE 10000 M (R104) and VERT. SIZE 2500 M (R106) adjustments are found on the small hinged panel on the top center of the indicator (fig. 76). With the RANGE SELECTOR switch set to 10000 M, adjust R104 until the vertical raster size just covers the CRT. With the RANGE SELECTOR switch in the 2500 M position, adjust R106 for a full vertical raster. Readjust R4409 (*f* above).

k. The INTENSITY BALANCE adjustment (R112) is located near the VERT. SIZE adjustments. It is used to set the intensity of the 2,500-meter sweep. Adjust R112 until the intensity of the 2,500-meter sweep is equal to that of the 10,000-meter sweep.

l. The AUXILIARY INTENSITY adjustment (R110) is found next to the INTENSITY BALANCE adjustment. It is used to adjust the brightness of the crt raster. Turn the INTENSITY control on the front panel fully ccw. Adjust R110 until the raster is just visible on the crt.

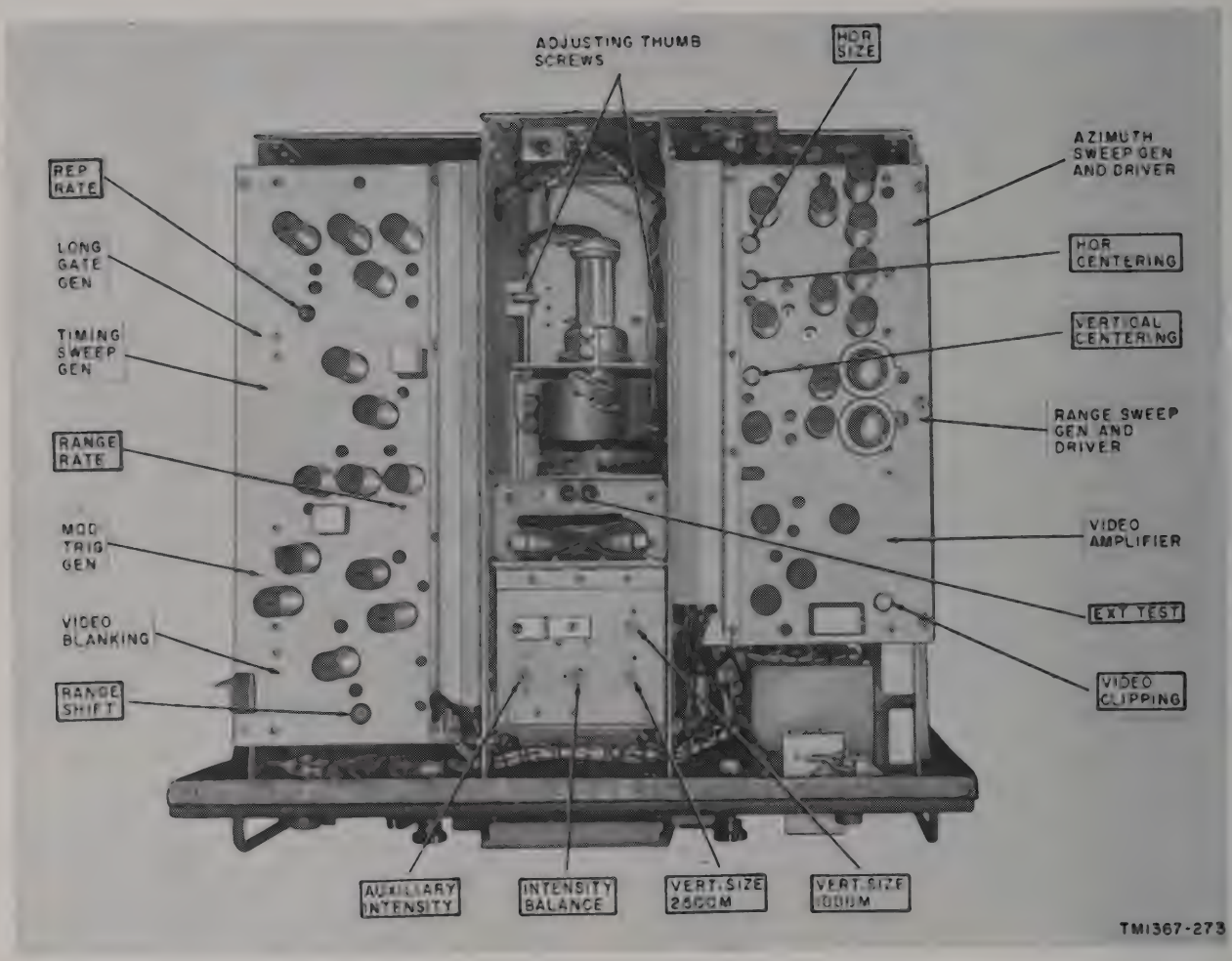


Figure 76. Azimuth and Range Indicator IP–375/MPQ–4A, top view.

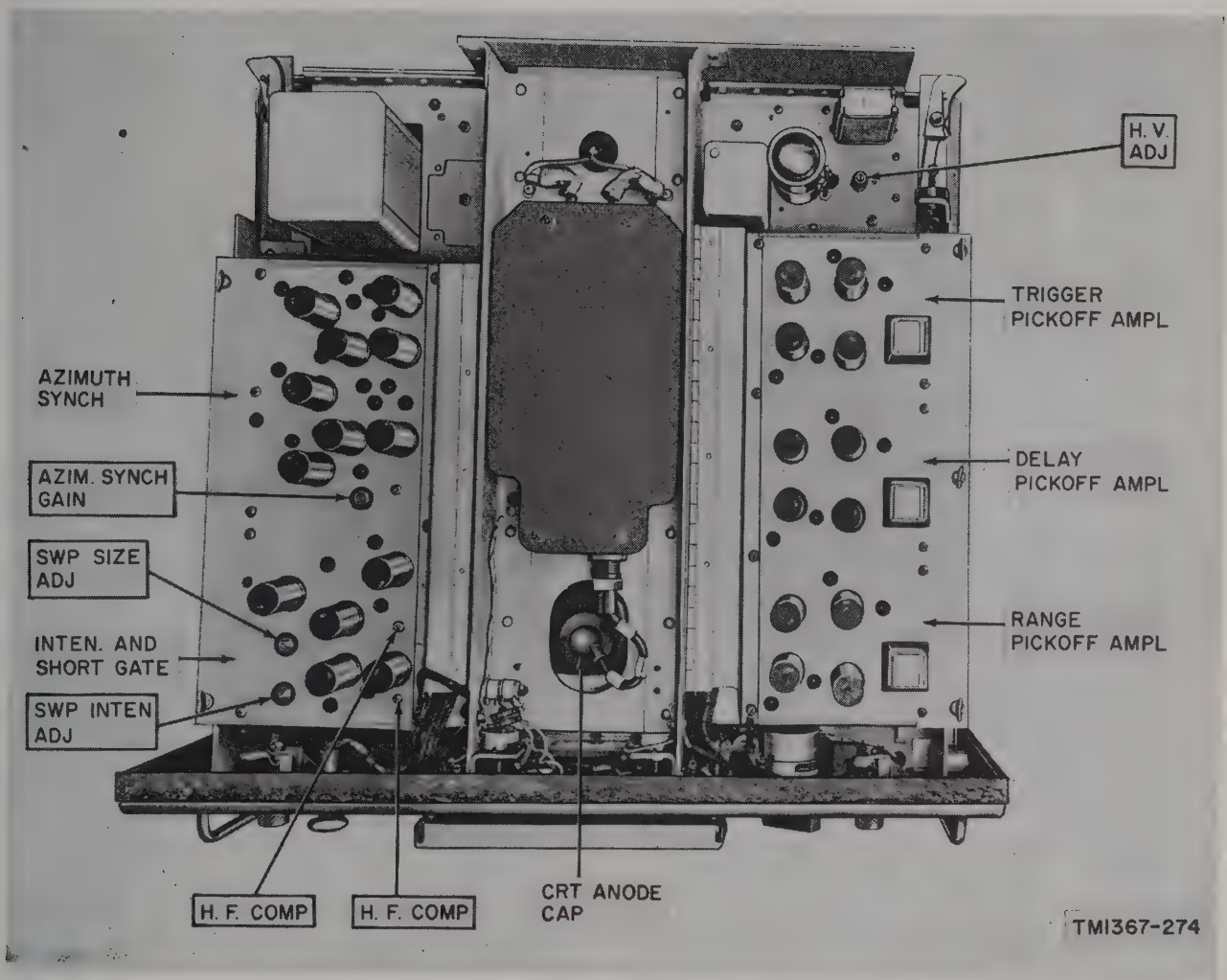


Figure 77. Azimuth and Range Indicator IP–375/MPQ–4A, bottom view.

91. Computer Adjustments

The computer requires no adjustment unless a mechanical subassembly is overhauled or an electrical subassembly is replaced.

92. Control-Power Supply Adjustments

Control-Power Supply C–2014/MPQ–4A is the control unit for the entire radar set, and it also contains the power supply for the control-indicator group.

a. Connect Multimeter TSO–352/U between TB601–2 (fig. 73) and ground.

b. Set the TEST METER SELECTOR switch (fig. 27) to the —220V position.

c. Adjust R634 (fig. 73) until a reading of —220 volts is obtained on the TEST METER. With this adjustment properly accomplished, the remaining regulating circuits will seek the proper levels.

d. Check the reading of the TEST METER with the reading on the multimeter.

93. Klystron Adjustments

The klystron drive assembly is adjusted so that the repeller voltage will track as the frequency of the local oscillator is changed. The klystron drive assembly is alined at the factory and requires adjustment only when the klystron tube is replaced.

Note. When lack of time or facilities prevent making the following adjustments after replacing the klystron, the tube may be tuned to operate properly on a single frequency by following the procedure in *d*(2) and (3) below and observing the range markers on the indicator B-scope.

Warning: Be extremely careful when making adjustments inside the receiver compartment with power on. Voltages up to 300 volts are present.

a. At the control-power supply panel (fig. 26), turn the MAIN POWER switch ON. After 5 minutes, press the START button, and allow the system to operate for 15 minutes.

b. At the indicator panel (fig. 25), turn the MARKERS ON switch to ON and adjust the VIDEO and IF GAIN controls until the receiver noise is noticeable on the B-scope.

c. At the control-monitor panel (fig. 23), place the TEST METER SELECTOR switch in the AFC XTAL position and A. F. C. MANUAL switch in the MANUAL position.

d. Tune the klystron to the proper frequency by proceeding as follows:

(1) Connect Oscilloscope AN/USM–32 to the VIDEO TEST jack on the front panel.

(2) With the L.O. CAVITY switch, using both RAISE and LOWER positions, tune carefully for maximum range markers as observed on the oscilloscope. Two points of maximum markers will be found. The point *lower* in frequency (observed with L.O. CAVITY switch in RAISE position) should be chosen.

Note. If the amplitude of the range markers is not satisfactory, adjust R1333 (fig. 65) on the afc assembly until sufficient amplitude is obtained.

(3) Adjust R1505 LEVEL ADJUST (fig. 67) for maximum crystal current on the TEST METER. Repeat the procedures in (2) above if the range markers have decreased in amplitude.

Caution: In the following steps, do not touch the free probe on the multimeter to ground.

(4) Connect Electronic Multimeter TS–505A/U as shown in figure 78. Set the meter on the 20V scale.

(5) Measure repeller voltage at J1507. Record this voltage as V_0. See that the klystron is still properly tuned for maximum crystal current on the TEST METER with the multimeter in the circuit.

(6) Actuate the L.O. CAVITY switch in the RAISE position for one-half turn of the klystron tuning shaft. Adjust R1505 LEVEL ADJUST for maximum crystal current with the multimeter reading the repeller voltage at J1507. Record this voltage V_1.

(7) Actuate the L.O. CAVITY switch in the LOWER position for 1 full turn of the klystron tuning shaft from its position ((6) above). Adjust R1505 LEVEL ADJUST for maximum crystal current with the multimeter reading the repeller voltage at J1507. Record this voltage as V_2.

(8) Actuate the L.O. CAVITY switch in the RAISE position for one-half turn of the klystron tuning shaft to return to the V_0 position.

(9) At the control-power supply panel, depress the STOP button and turn the MAIN POWER switch to OFF.

(10) Decouple the motor drive from the klystron; be very careful not to disturb the position of the klystron tuning screw.

(11) Turn the MAIN POWER switch to ON. After 5 minutes, depress the START button.

(12) Actuate the L.O. CAVITY switch in the RAISE position for one-half turn of the tuning shaft and record the multimeter reading as V_3. Actuate the switch in the LOWER position for 1 full turn of the tuning shaft and record the multimeter reading as V_4. The difference between these two voltages is V_5 and should be equal to the difference between V_1 and V_2. If the same difference voltage is not obtained, adjust R1502 SLOPE ADJUST (fig. 67) until V_5 equals V_0.

(13) Depress the STOP button and turn the MAIN POWER switch to OFF. Couple the motor drive to the klystron and turn on the power again.

(14) Adjust R1505 LEVEL ADJUST so that the voltage at J1507 is equal to V_0. If this cannot be accomplished, follow the procedure in (15) below. If a satisfactory reading is obtained, follow the procedure in (18) below.

(15) To adjust R1505 LEVEL ADJUST properly, proceed as follows:

(*a*) Depress the STOP button and turn the MAIN POWER switch to OFF.

(*b*) Loosen the klystron drive coupling again, but be careful not to disturb the tuning screw; turn the power back on.

(*c*) Actuate the L.O. CAVITY switch to run the klystron drive assembly until V_0 comes well within the range of R1505 LEVEL ADJUST. (The potentiometer setting should be approximately midposition for a voltage reading of V_0.)

(*d*) Turn off the power, tighten the drive coupling, and again turn on the power.

(16) Repeat the procedures in *d*(2) and (3) above.

(17) Actuate the L.O. CAVITY switch to detune the klystron, and then retune for maximum range markers on the oscilloscope. The multimeter reading should be equal to $V_0 \pm \frac{1}{2}$ volt.

(18) Set the A.F.C.-MANUAL switch to A.F.C. and check to see that there is no decrease in the intensity or amplitude of the range markers. If the range markers are not as good in A.F.C., adjust L1301 (fig. 65) on the the AFC assembly very slightly.

(19) When properly locked in AFC, adjust the L.O. ADJUST control (fig. 67) for a crystal current approximately half-scale on the TEST METER. Loosen the locknut on the control before making the adjustment.

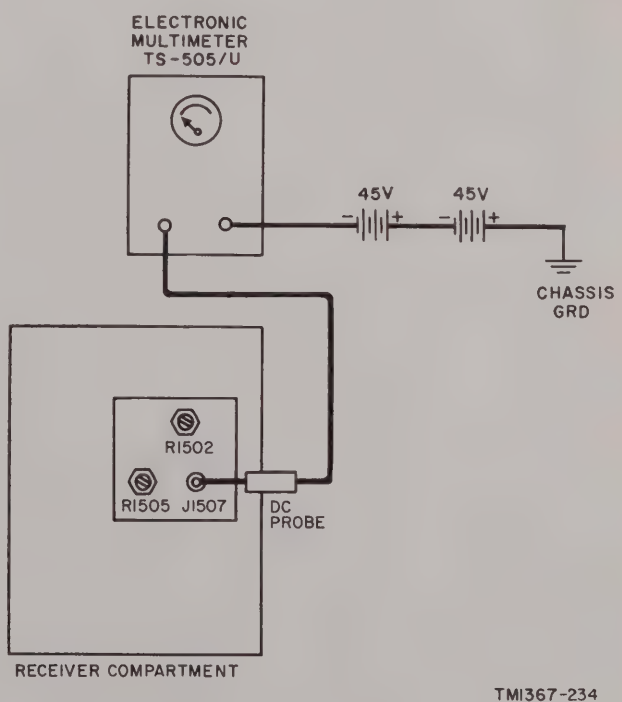


Figure 78. Test circuit for klystron tuning.

94. Stc Adjustments

The three adjustment controls for the stc assembly are found on the top portion of the chassis (fig. 66). They have been preset at the factory and should ordinarily require no adjustment. The interrelationship between stc sensitivity adjust R4708 and time constant adjust R4712 is extremely critical. These two adjustments should be referred to a higher echelon. The adjustment procedure for R4714, stc amplitude adjust, is given below.

a. Loosen the two knurled thumbscrews on the front flange of the stc chassis and slide the chassis part way out.

b. Disconnect W1508 (fig. 17) from J4702.

c. Connect Oscilloscope AN/USM–32 to J4702 (fig. 66); use the 6-foot cable supplied with the oscilloscope.

d. Adjust the oscilloscope for a presentation of the stc sawtooth on the B-scope. Refer to TM 11–5123.

e. Adjust R4714 (fig. 66) until the amplitude of the wave form is 6 volts.

f. Disconnect the oscilloscope from J4702 and reconnect W1508 to the same jack.

g. Slide the chassis back into position and tighten the thumbscrews.

95. Transmitter Adjustments

a. General. The transmitter operates on a fixed frequency and requires no tuning. Certain voltage adjustments, (*b* below) however, are required when thyratron switch tube V1104 is replaced. The performance of relay K1103 can be checked, after replacement, with the facilities provided in the equipment (*c* below). This relay is located on the rear of the transmitter compartment door. Two operators are needed to make the transmitter adjustments: one at the control-indicator group and the other at the receiver-transmitter group.

Warning: Do not reach into the transmitter compartment during the following adjustments. Voltage in excess of 30,000 volts is present. Avoid touching TB1101 and TB1102 mounted on the rear of the transmitter door. These boards have a potential of 300 volts.

b. Thyratron Switch Adjustments.

(1) Open the transmitter compartment door and close shorting switches S1103, S1105, and S1107 (fig. 62).

(2) On the control-power supply panel, turn the MAIN POWER switch to ON.

Caution: Do not adjust T1107 while the system is in radiate operation Make all adjustments during the 5-minute delay period before radiation or not less than 3 minutes after the equipment has stopped radiating.

(3) Adjust T1107 (fig. 62) for a reservoir voltage reading which is .3 volt higher than the voltage stamped on the base of the thyratron switch tube. Read the reservoir voltage on M1101 (fig. 62).

(4) When the READY lamp lights, press the START button and observe the two windows near the top of the electrode structure inside V1104. Note a bright flickering violet glow, which will be extinguished when the START button is released. This indicates that the tube is firing through because of high reservoir voltage. If the glow is steady rather than flickering, refer to (7) below before continuing this procedure.

Caution: Press the STOP button immediately if a steady cherry-red glow is seen through the upper window of the tube. Refer to (8) below.

(5) Press the STOP button and after 3 minutes, decrease the reservoir voltage in amounts of .1 volt (starting and stopping the modulator after each adjustment) until a steady bright violet glow is observed through both windows. The glow will remain after the START button is released.

(6) Adjust the MAGNETRON POWER variac until the MAGNETRON CURRENT meter reads approximately 22 ma. The reservoir voltage is now properly set.

(7) If the thyratron exhibits a steady violet glow when the START button is initially pressed, press the STOP button and increase the reservoir voltage by another .3 volt. Repeat the procedures in (4) through (6) above.

(8) If a steady cherry-red glow is observed through the upper window and a steady bright violet glow is observed through the lower window, the tube has a *hot plate* resulting from too low a reservoir voltage. This condition can result in serious damage to the tube. Adjust T1107 for an increase of .6 volt and repeat the procedures in (4) through (6) above.

c. Adjustment of K1103 (fig. 79). This adjustment is preset at the factory and determines the amount of current that will trip the overload relay and open the magnetron filament circuit. To check and adjust K1103 after replacement, proceed as follows:

(1) On the control-power supply panel, turn the MAGNETRON POWER variace fully counterclockwise.

(2) Open the transmitter compartment door and close shorting switches S1103, S1105, and S1107 (fig. 62).

(3) Press the START button on the control-power supply panel and turn the variac until the MAGNETRON CURRENT meter reads 16 ma. Note whether K1103 has picked up. (K1103 pick-up causes the voltage at terminals 1 and 3 of T1104 to decrease from 120 volts ac to zero). If K1103 does not pick up, continue with the procedure in (4) below.

(4) Turn off the modulator by pressing the STOP button on the control-power supply panel. Open shorting switches S1103, S1105, and S1107.

(5) Adjust R1104 (fig. 79) either cw or ccw. Close shorting switches and turn the modulator back on by pressing the START button. Check whether the procedure followed in (3) above will produce K1103 pickup within the range of magnetron current of 13 to 16 ma. Repeat the procedures in (4) and (5) above until K1103 picks up at the correct magnetron current reading.

Caution: If possible, when the magnetron tube is in operation, maintain the magnetron current above 16 ma to prevent damage to the tube.

d. Adjustment of K1102 and K1101.

(1) Resistor R1105 is the adjustment for K1102 and is preset so that K1102 drops out when the modulator reverse current reaches 200 ma. This adjustment is not made in the field.

(2) Resistor R1106 is the adjustment for K1101 and is preset so that K1101 drops out when the high-voltage power supply current is in excess of 300 ma. This adjustment is not made in the field.

96. Low-Voltage Power Supply Adjustments

Power Supply PP–1588/MPQ–4A is the low-voltage power supply for the receiver-transmitter group.

a. Connect Multimeter TS–352/U between TB2002–12 (fig. 67) and ground.

b. Set the TEST METER SELECTOR switch (fig. 27) to —300V.

c. Adjust R1643 (fig. 69) until a reading of —300 volts is obtained on the TEST METER. With this adjustment properly accomplished, the remaining regulating circuits will seek the proper levels.

d. Compare the reading of the TEST METER with the reading on the multimeter.

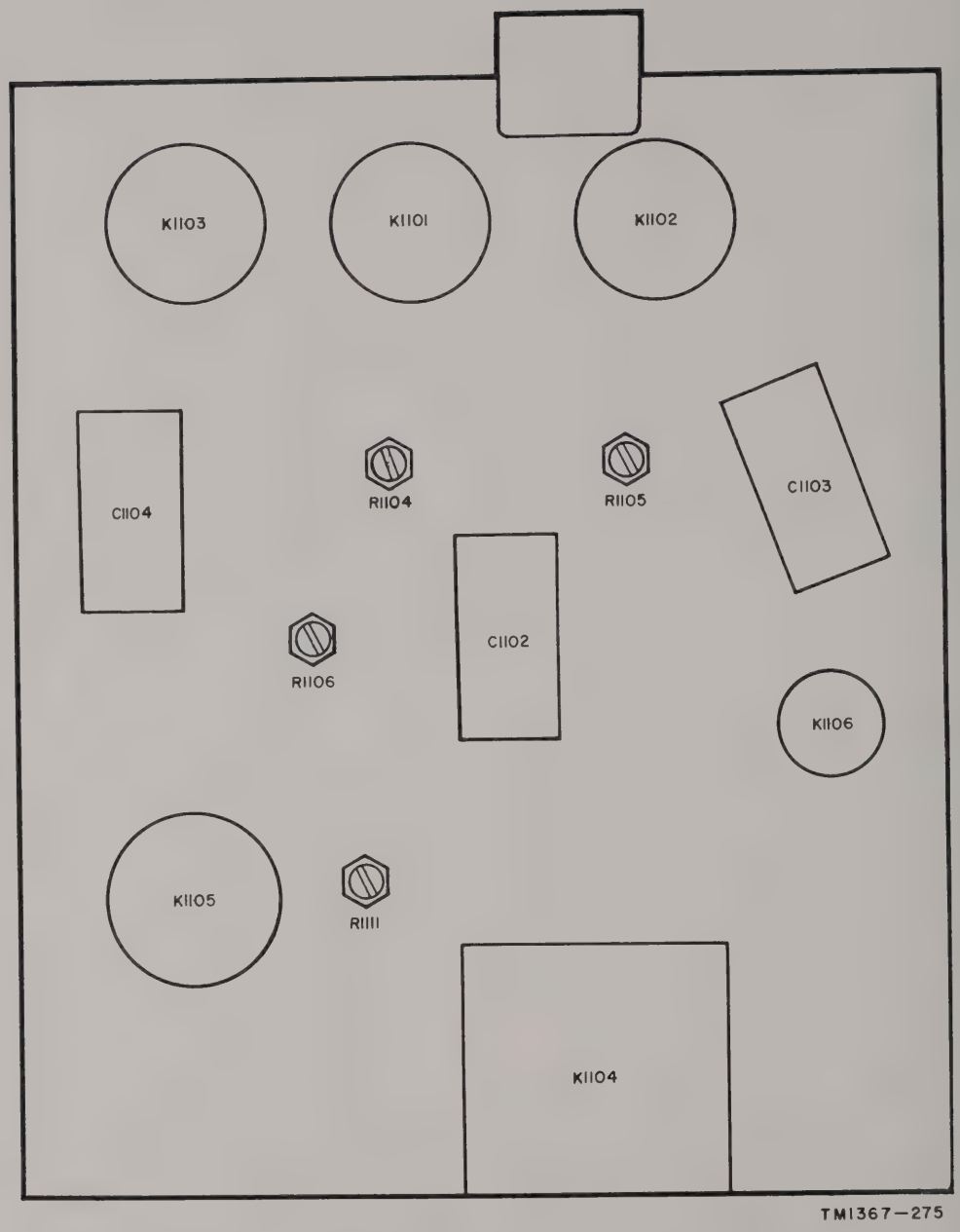


Figure 79. Modulator relay chassis, transmitter door, location of adjustments.

97. Antenna Adjustments

a. General. For installation or relocation alignments, refer to paragraph 41. Normally there are no other adjustments, unless faulty operation of the radar set can be traced to a maladjustment on the antenna.

b. Synchro Generator Zeroing Procedure. This procedure may be used for either azimuth of elevation synchro generators. When zeroing the two azimuth synchros, be sure that both are zeroed at exactly the same antenna azimuth position. To zero any one of the synchros, proceed as follows:

(1) Set the antenna azimuth (or elevation) to zero; use the AZIMUTH CCW CW control (or ELEVATION RAISE LOWER control).

(2) Remove connections S1, S2, and S3 from the synchro generator and reconnect as shown in A, figure 80. Use Multimeter TS–352/U.

(3) Unclamp the generator and turn it in its mounting until the meter reads 0.

(4) Change the meter connections as shown in B, figure 80. If the meter reads approximately 37 volts ac, the generator is near 0°. Perform the procedure in (8) below. If the meter reads approximately 193 volts ac, the generator is near 180° and must be rezeroed.

(5) Reconnect the meter as shown in A, figure 80.

(6) Turn the generator halfway around until the meter reads 0 again.

(7) Change the meter connections as shown in B, figure 80. The meter should now read approximately 37 volts and the generator is now near 0°.

(8) Reconnect the meter as shown in C, figure 80. Set the meter on its lowest range and turn the generator carefully for a minimum reading.

(9) Clamp the generator in this position and disconnect the meter leads. Reconnect S1, S2, and S3 connections for normal operation.

(10) Press the ELEVATION switch to RAISE or LOWER until the antenna elevation counter on the pedestal reads zero. (The lower beam is then horizontal.) Note whether the LOWER BEAM ELEVATION counter on the computer reads zero. If it does not, unclamp the synchro generator once again and position it until the computer counter reading is zero. Reclamp the generator securely in place. For a fine adjustment of the LOWER BEAM ELEVATION counter (within 2 mils of zero), use the elevation adjustment screw located directly underneath the counter, inside the computer drawer (fig. 20).

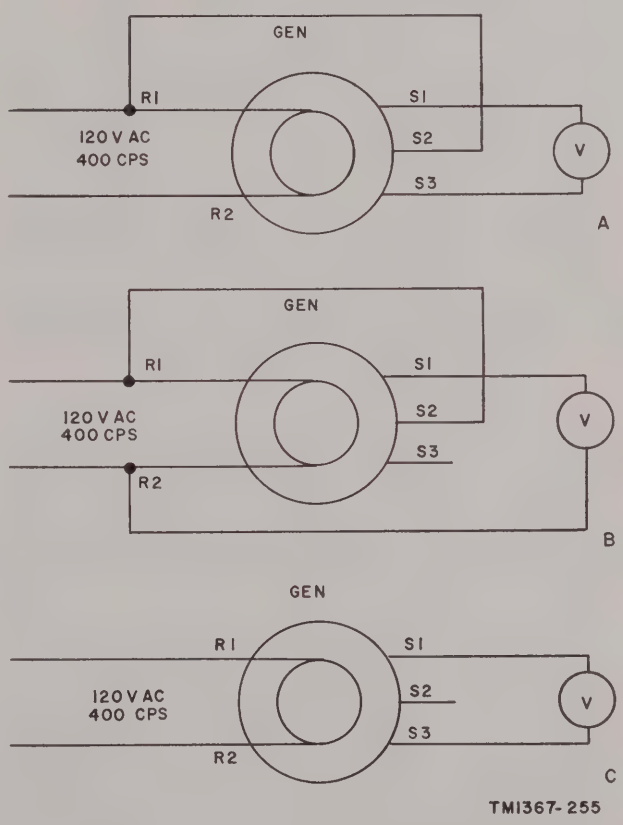


Figure 80. Synchro generator zeroing procedure.

CHAPTER 6
BASIC THEORY

Section I. GROUPING OF COMPONENTS

98. Systems Breakdown

a. The components of Radar Set AN/MPQ–4A may be divided into 10 systems according to their functions and as related to the over-all function of the radar set. The following chart lists the 10 systems, and references the paragraphs that list the component parts of each system.

System	Paragraph
Transmitting	100
RF	101
Receiving	102
Synchronizing	103
Indicating	104
Computing	105
Antenna positioning	106
Dc power supplies	107
Dehydrating	108

b. For detailed theory of the functioning of these components, refer to TM 11–1567.

99. Discussion of Radar Set Simplified Block Diagram
(fig. 81)

a. Transmitting System. The transmitting system receives synchronized low-level trigger pulses from the synchronizing system and generates high power RF pulses which are coupled through the waveguides to the RF system.

b. RF System. During transmission, the RF system conducts the high power pulses of RF energy from the transmitting system to the antenna. The antenna, or scanner, radiates this energy to the reflector, which directs the resultant beam into the desired search sector. During reception, the RF system intercepts RF energy echoes returning from targets in the scanned sector. These reflected echo pulses strike the reflector and are beamed into the scanner. From the scanner, the echo pulses pass through the wave guide to the receiving system.

c. Receiving System. The receiving system amplifies the RF energy echoes from the RF system and transforms them into video pulses. These video pulses are then applied to the indicating system.

d. Synchronizing System. The synchronizing system in the indicator generates synchronizing trigger pulses for the transmitting and indicating systems.

e. Indicating System. The indicating system displays video signals derived from the receiving system. This information from the receiver is presented on a B-scope, together with upper and lower beam strobe lines and an azimuth strobe line.

f. Computing System. The computing system determines the location of the desired target by means of manually inserted information received from the indicating and antenna positioning systems. A portion of the data-obtaining process is also accomplished through the electrical coupling between the computer and the indicator.

g. Antenna Positioning System. The antenna positioning system controls the movement of the antenna in azimuth and elevation.

h. Dc Power Supplies System. The dc power supplies system provides the dc voltage required by the various components of the radar set. This system is not shown in the block diagram of the radar set.

i. Power Distribution and Control System. The power distribution and control system distributes and controls the application of primary ac power required by the various components of the radar set. This system is not shown in the block diagram of the radar set.

j. Dehydrating System. The dehydrating system maintains the waveguides at a safe, dry, air pressure over a wide variety of climatic conditions.

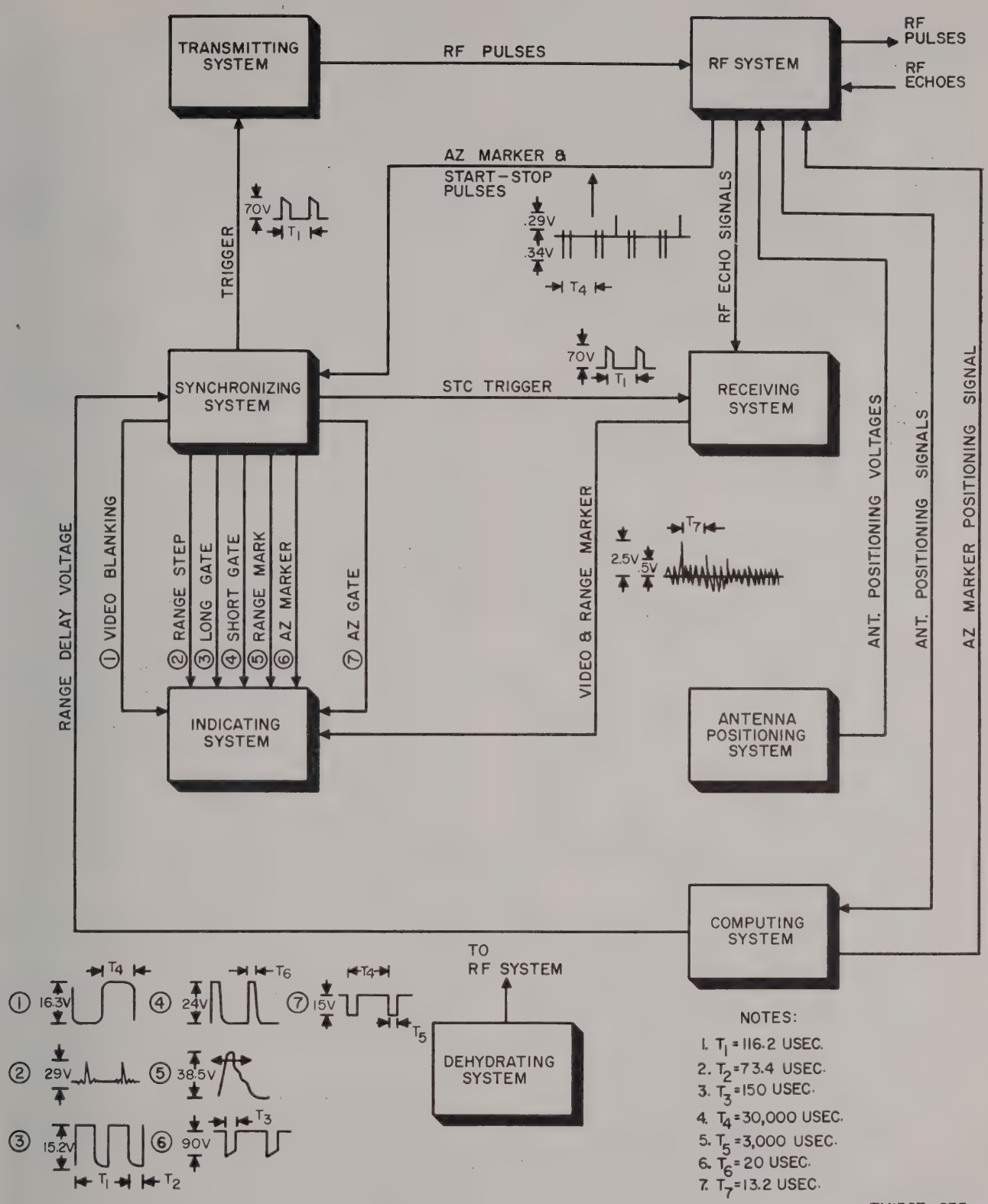


Figure 81. Radar Set AN/MPQ-4A, simplified block diagram.

Section II. DESCRIPTION OF INDIVIDUAL SYSTEMS

100. Transmitting System (fig. 82)

The transmitting system includes the trigger amplifier, modulator, magnetron, and high-voltage power supply.

a. Trigger Pulse Amplifier AM–1537/MPQ–4A. The trigger amplifier serves to amplify the trigger pulses received from the modulator trigger generator in the indicator. These pulses are at a pulse repetition frequency (prf) of 8,600 pulses per second (pps) with blanking, and are used to trigger the modulator thyratron switch.

b. Modulator. The modulator consists of thyratron switch V1104, pulse-forming network Z1101, pulse transformer T1106, charging diode V1106, and reverse current diode V1103.

(1) *Thyratron switch V1104.* The thyratron switch is fired by the trigger amplifier input at the rate of 8,600 pps, and discharges the pulse-forming network, through saturable inductor L1101, at the same rate.

(2) *Pulse-forming network Z1101.* This network is an artificial transmission line which determines the width (.25 μsec) of the positive pulses applied to pulse transformer T1106. The amount of inductance and capacitance in the line determines the length of time the network remains charged before discharging through V1104.

(3) *Charging diode V1106.* The charging diode serves as a gate for the 9-kv output from the high-voltage power supply. This voltage charges the pulse-forming network during the blanking period when no pulses are being received from the indicator.

(4) *Reverse current diode V1103.* This circuit is provided as a bypass to ground for any negative voltage developed when Z1101 is discharging.

(5) *Pulse transformer T1106.* The pulse transformer supplies a negative pulse of approximately 26 kilovolts (kv) to the magnetron.

c. Magnetron. The magnetron generates the RF pulse which is fed through the waveguide to the antenna. The frequency of this pulse is 16,000 megacycles (mc), modulated at a prf of 8,600 pps as determined by the trigger pulse from pulse transformer T1106.

d. High-Voltage Power Supply. The high-voltage power supply provides a peak voltage of 9-kv which is used to charge pulse-forming network Z1101.

101. Rf System (fig. 83)

The RF system includes the antenna (scanner), reflector, duplexer, ferrite isolator, directional coupler, echo box, and circular polarizer.

a. Antenna AS–835/MPQ–4A. High power RF pulses from the transmitting system are received by the scanner through the ferrite isolator, duplexer, and associated waveguides. The RF energy travels around a wave path between the inner and outer scanner cones and comes out through the output horns and radome to the reflector. During reception, the echo pulses from the reflector pass through the scanner to the receiving system. Two wave paths are provided inside the scanner, one for the upper beam and the other for the lower beam.

b. Antenna Reflector AT–643/MPQ–4A. The reflector directs and shapes the transmitted beams from the scanner. These two beams are 14.25 mils high (vertical plane) and 17.8 mils wide (horizontal plane). The two beams scan the same 450-mil azimuth angle, but are separated by a nominal angle of 36 mils. During reception, returned echo pulses from the target are picked up by the reflector and sent to the scanner. The reflector is fixed in position in relation to the scanner, but the complete assembly is movable both in elevation and azimuth by means of the antenna positioning system.

c. Duplexer CU–476/MPQ–4A. The duplexer provides a means of using the same antenna for both transmitting and receiving. During transmission, it serves as a high-speed electronic switch which permits the passage of the RF energy to the antenna. At the same time, the duplexer TR tube blocks the passage of the RF energy to the receiver and prevents damage

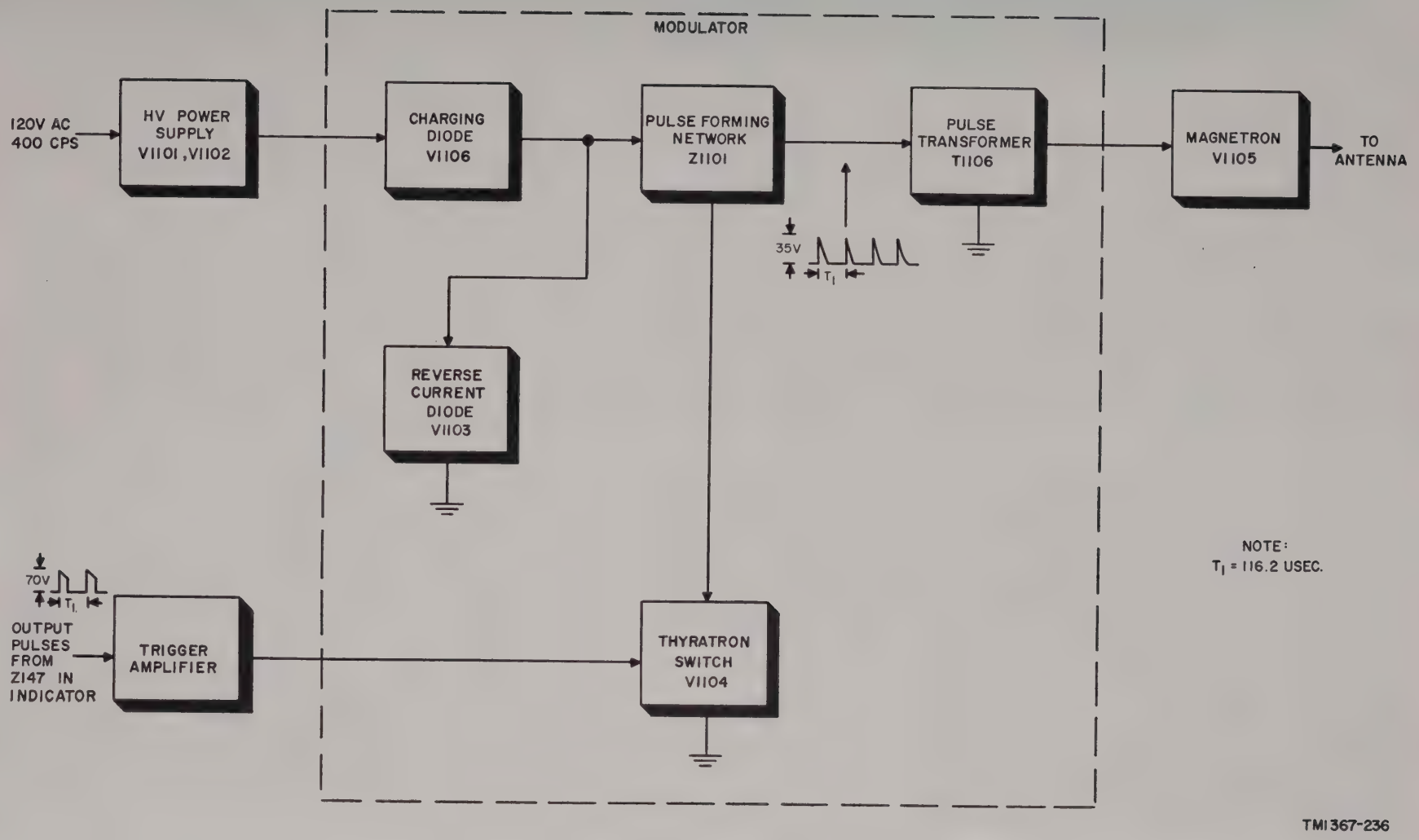


Figure 82. Transmitting system, qualified block diagram.

to the receiver elements. During the receiving period, the duplexer feeds the incoming signal to the receiver and, simultaneously, prevents this signal from being dissipated in the magnetron.

d. Ferrite Isolator. The ferrite isolator is located between the duplexer and the transmitter. It serves to dissipate reflected waves caused by a possible mismatch between the scanner and the magnetron. During transmission, these reflected waves may cause a shift in the magnetron frequency.

e. Directional Coupler CU–399/MPQ–4. The directional coupler is a special section of waveguide connected in the main waveguide between the receiver-transmitter group and the scanner. It is used to take off a sample of the RF energy being transmitted. From the coupler, this sample of energy is fed to the echo box or to a test set.

f. Tuned Cavity FR–111/MPQ–4A. The tuned cavity, or echo box, is provided as a means of checking radar system performance within the frequency range of 15,800 to 16,200 megacycles per second. It includes a crystal, microammeter, and facilities for manual tuning. A potentiometer is also included to adjust the meter to read within the central portion of the scale. The RF energy received from the directional coupler is applied to the echo box cavity where a ringing (resonance) is obtained if the box is properly tuned. When resonance occurs, a small portion of the RF energy is applied to the crystal which serves as a detector and produces a peaked reading on the microammeter; another portion of the RF energy is reflected back into the directional coupler and then into the main waveguide, where it appears as a received signal. The duration of this signal, as presented on the indicator crt, is a function of the transmitted power, the noise level of the receiving system, and the Q of the echo box cavity.

g. Circular Polarizer MX–2219/MPQ–4A. The circular polarizer is mounted between the scanner and the reflector for the purpose of reducing the radar return from raindrops. These stray reflections appear as clutter on the indicator crt. The circular polarizer is designed to change the polarization of the transmitted energy and filter the reflected waves. Reflections from smooth regular objects, such as rain drops, are canceled out because of this change in phase. The sharp edges and angles of mortar shell distort reflected rf energy in such a manner that the returned target echoes will be permitted to pass through the circular polarizer into the scanner.

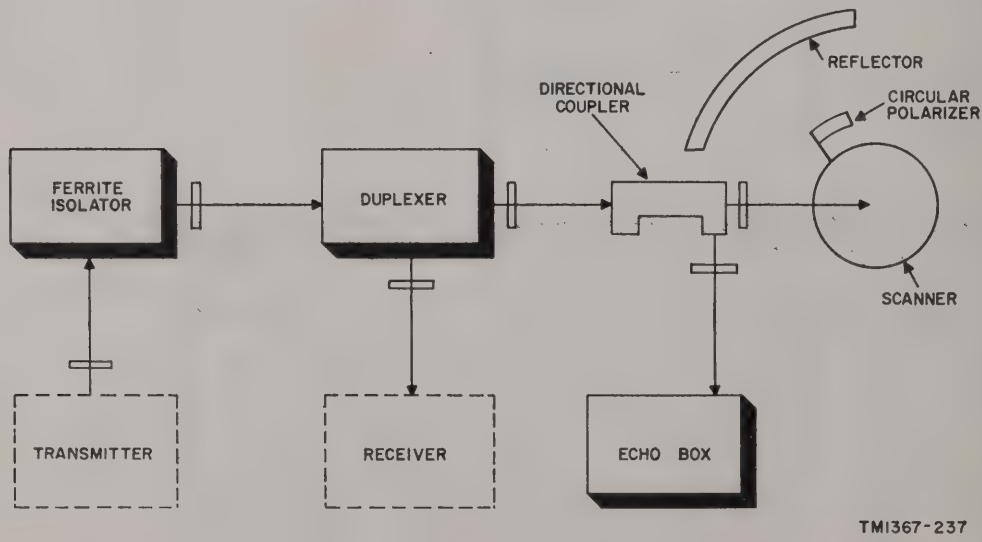


Figure 83. RF system, simplified block diagram.

102. Receiving System
(fig. 84)

The receiving system includes the mixer (part of duplexer), local oscillator, if amplifier, afc assembly, and the stc assembly.

a. Mixer. Returned echo pulses from the target are received by the antenna and combined with a local oscillator frequency in the mixer part of the duplexer. The two IF crystals in the duplexer detect the difference-frequency signal, and feed 30-mc output to the IF amplifier.

b. Local Oscillator. The local oscillator is a klystron tube which generates a frequency 30 mc lower than the transmitter frequency of 16,000 mc. This oscillator frequency is coupled to the mixer crystal in the duplexer. The oscillator is tuned manually by means of a motor which is coupled directly to the klystron tuning shaft or tuned automatically with the afc circuits.

c. Intermediate Frequency Amplifier AM–1538/MPQ–4A. The 30-mc IF pulses from the duplexer are amplified and detected in the IF amplifier. The resultant video signals are amplified again and sent to the video amplifier in the indicator, where they are displayed on the B-scope as intensified dots.

d. Receiver Control C–2016/MPQ–4A. The receiver control, or afc assembly, is used to maintain a constant frequency difference of 30 mc between the magnetron frequency and the local oscillator frequency. A portion of the afc mixer crystal output is fed to a discriminator circuit in the afc assembly. The output of the discriminator is used to produce a control voltage which is proportional to the IF drift. This control voltage is fed back to the kystron to compensate for the original frequency drift and to reestablish the correct difference frequency.

e. Receiver Control C–2015/MPQ–4A. The receiver control, or stc assembly, is used to control the gain of the IF amplifier so that targets at all ranges will appear on the indicator B-scope with the same intensity. Timing pulses from the modulator trigger generator in the indicator are set to the stc assembly and initiate an RC time constant. The length of the time constant is equal to the range sweep, and the IF gain will decrease as the target range decreases.

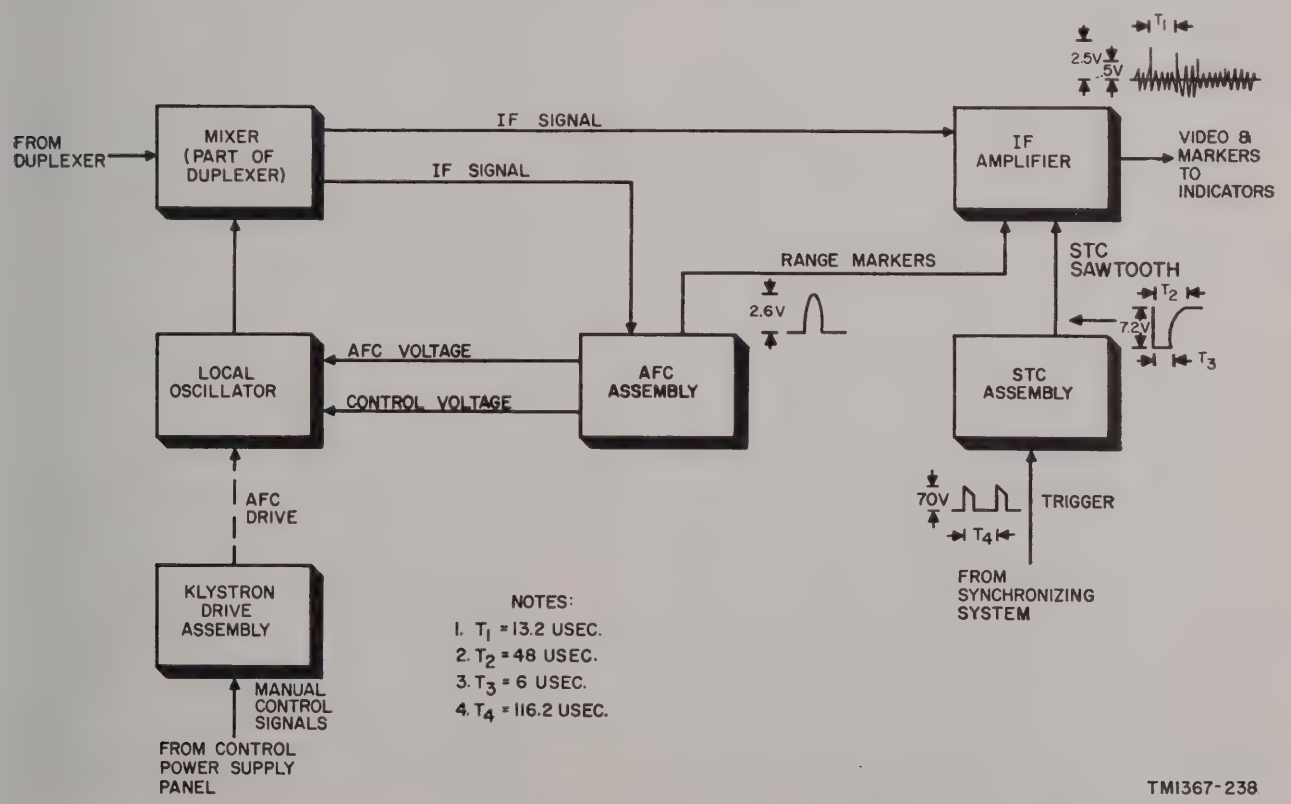


Figure 84. Receiving system, simplified block diagram.

103. Synchronizing System
(figs. 85 and 86)

a. Long Gate Generator. The pulse repetition rate of the radar set is determined by the frequency of the range trigger generated by the long gate generator. This timing is controlled by means of a temperature-compensated Hartley oscillator which generates an 8,600-cps sine wave (A, fig. 86). The sine wave initiates a 10,000-meter range gate (B, fig. 86), which in turn starts a linear timing sweep for the three pickoff amplifiers.

b. Timing Sweep Generator. The timing sweep generator produces a highly linear sweep voltage (C, fig. 86) for the three pickoff amplifiers. This timing sweep is initiated by the start of the long gate. After the sweep has reached a predetermined voltage level, a signal is fed back to the long gate generator which extinguishes the long gate. This is turn shuts off the timing sweep generator.

c. Pickoff Amplifiers. All three pickoff amplifiers are identical in circuitry and serve to generate a pulse, using the timing sweep output and a variable dc voltage. The output trigger generated varies in time (with regard to the start of the timing sweep) as the dc pickoff voltage input is varied.

(1) *Range zero trigger pickoff amplifier.* This amplifier receives its variable dc voltage from RANGE ZERO potentiometer R116. By varying the range zero adjustment, the trigger output pulse (D, fig. 86) is displaced in time until the transmitter pulse agrees with the zero computer range on the B-scope. This synchronizes the transmitter with the computer in respect to range.

(2) *Delay trigger pickoff amplifier.* The delay trigger pickoff amplifier receives its variable dc voltage from EXPANDED SWEEP DELAY control AT101. Control AT101 is a variable resistor which controls the range delay. The output trigger (E, fig. 86) can be delayed in 1,000-meter steps throughout the 10,000-meter range by varying AT101. This output is fed to to the short gate and intensifier circuits to initiate the short gate and delayed (expanded) sweep.

(3) *Range marker trigger pickoff amplifier.* This amplifier receives its variable dc voltage from potentionmeter R836 in the computer range subassembly. The trigger output (F, fig. 86) is sent to the video amplifier and appears on the B-scope as a range strobe line which is used to bisect the target echo indication.

d. Modulator Trigger Generator. The modulator trigger generator receives an input pulse from the range zero trigger pickoff amplifier. After being amplified, this pulse (G, fig. 86) is shaped in a blocking oscillator and sent to the trigger amplifier in the transmitter. During dead time, the trigger generator is cut off by a blanking pulse from the azimuth synchronizer (*e* below).

e. Azimuth Synchronizer. The azimuth synchronizer separates the positive and negative pulses received from the scanner (H, fig. 86) and uses the positive pulse to obtain the azimuth marker or strobe line (J, fig. 86). The azimuth strobe line is produced on the B-scope by passing the pulse from the azimuth synchronizer to the intensifier and from there to the grid of the crt. The negative pulse from the scanner is used to generate an azimuth sweep gate (K, fig. 86) which starts and stops the azimuth sweep. The azimuth synchronizer also produces a blanking pulse (I, fig. 86) which cuts off the modulator trigger generator. This prevents the transmitter from firing during the scanner dead time (a period of 3,000 μsec when the antenna is changing beams). In addition, the synchronizer is the source of the range shift voltage (L, fig. 86) which produces the 500-meter displacement of the upper beam presentation of the B-scope.

f. Video Blanking and Range Shift.

(1) *Video blanking.* The video blanking circuit inverts the range shift gate from the azimuth synchronizer. This inverted gate, together with the uninverted range shift gate, provides optional signals (M, fig. 86) for blanking the video amplifier during either the upper or lower azimuth scan. The duration of the blanking period for either beam is 30,000 μsec (M, fig. 86).

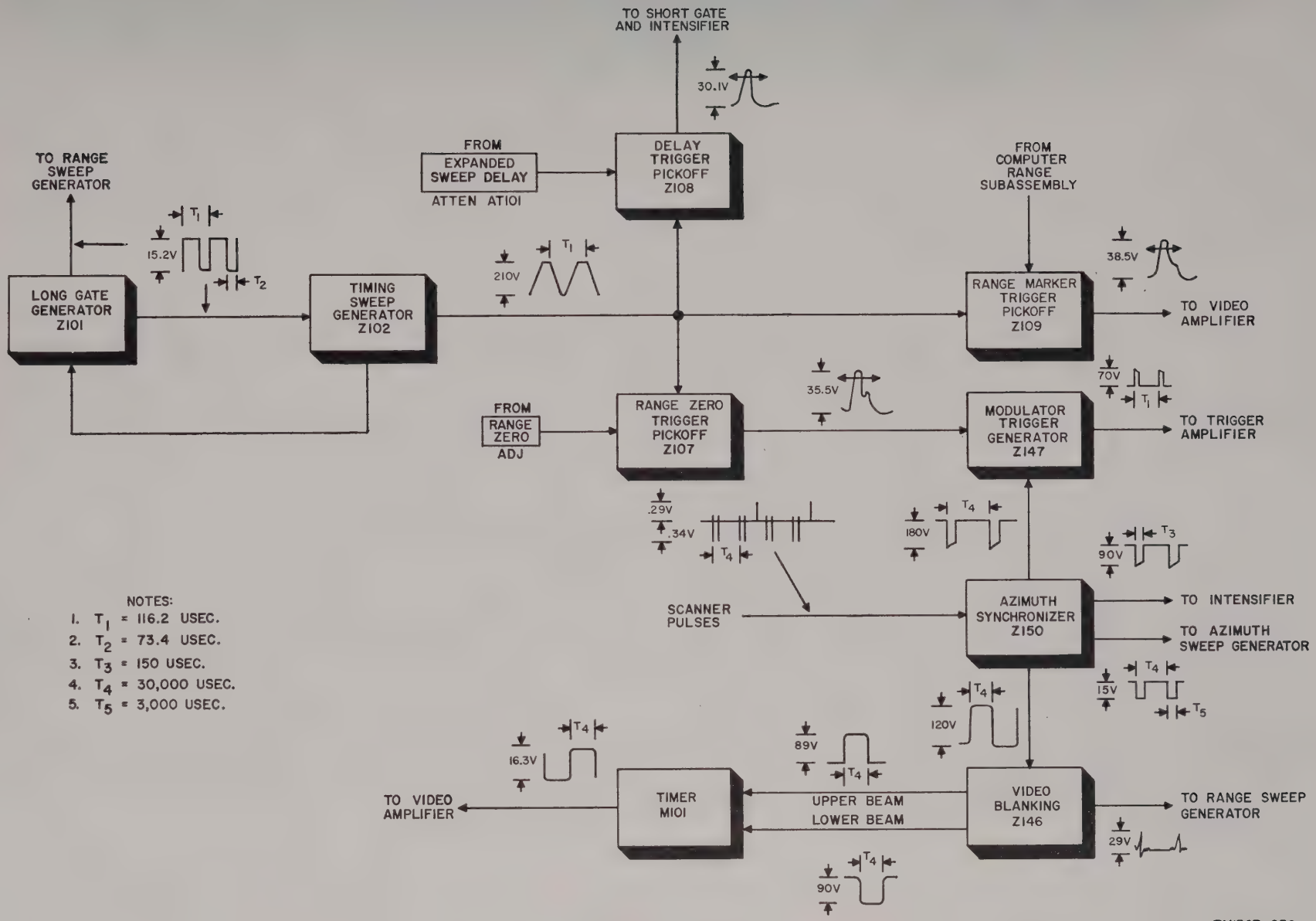


Figure 85. Synchronizing system, simplified block diagram.

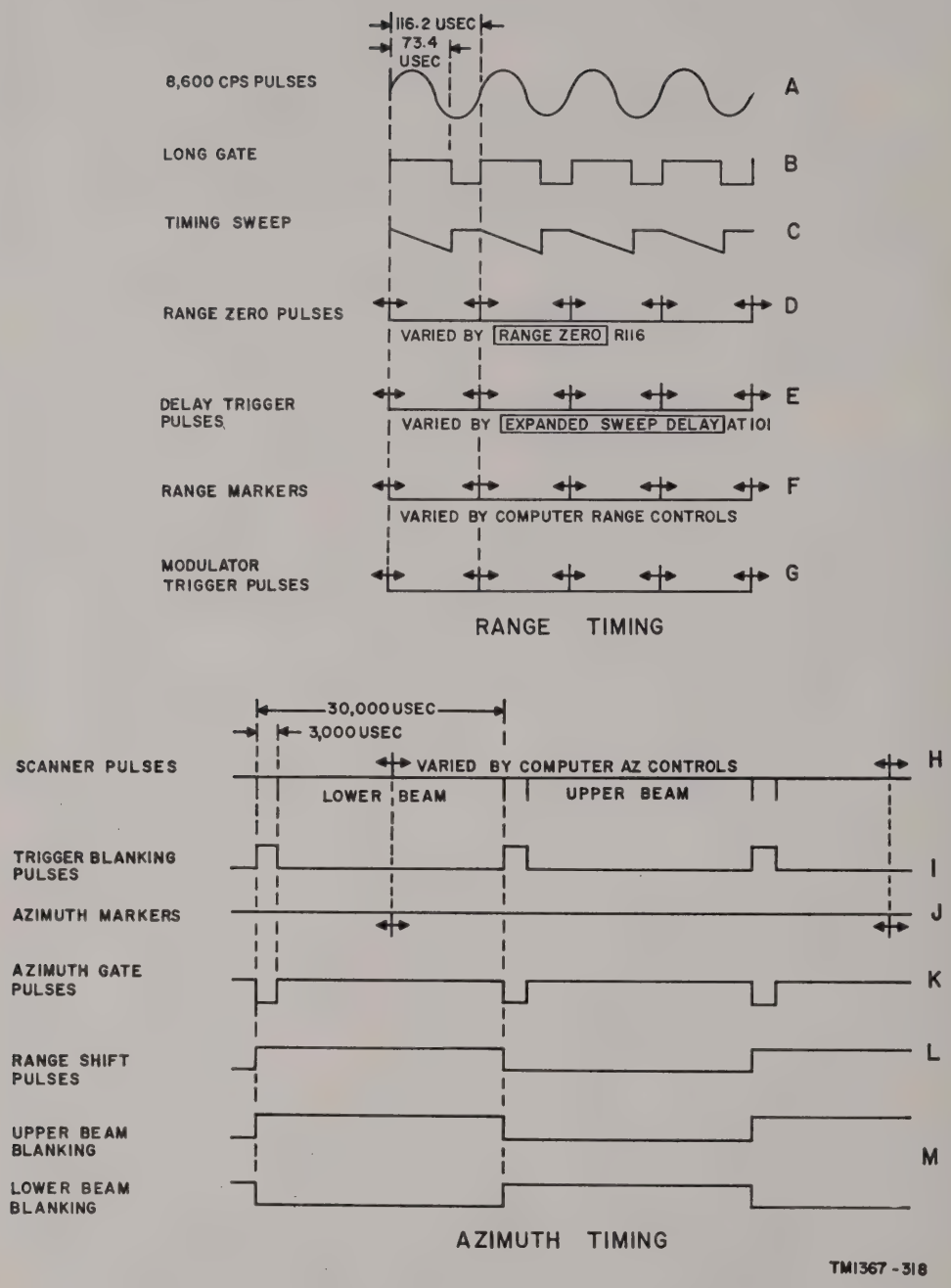


Figure 86. Synchronizing system, timing diagram.

(2) *Range shift.* A divider network divides down the range shift gate and clamps the lower level at ground potential. This produces a positive gate which is sent to the range sweep generator to shift the upper beam presentation to a greater range.

104. Indicating system (fig. 87)

a. Range Sweep Generator. The range sweep generator produces the vertical sweep on the B-scope. It is trigged by the 10,000-meter gate or the 2,500-meter gate, depending on the position of RANGE SELECTOR switch S101.

b. Azimuth Sweep Generator. The azimuth sweep generator produces the horizontal sweep on the B-scope. It is controlled by the azimuth gate from the azimuth synchronizer.

c. Short Gate and Intensifier. The short gate and intensifier circuits are the source of the 2,500-meter delayed sweep (short gate) and the intensified range band on the 10,000-meter sweep. The short gate output, with a pulse duration of 20 μsec, is applied internally to the intensifier and also externally through RANGE SELECTOR switch S101. This same output is used to trigger the range sweep generator. The intensified range band is produced by applying a positive gate to the crt grid for an interval of 20 μsec during the long gate sweep.

d. Video Amplifier. The video amplifier receives and amplifies the detected video signal from the if amplifier, and supplies the crt cathode with video information. Range calibration and range strobe marks are also received with the video signal, and applied to the B-scope after amplification. The range marks are generated by a delay cell in the afc assembly and inserted into the third stage of the IF amplifier.

e. High-Voltage Oscillator V161. The high-voltage oscillator is an audio phase shift oscillator used to supply the voltage needed for the high-voltage rectifier and multiplier. Frequency of oscillation is approximately 4 kc. The amplitude of the sine wave output is approximately 2,000 volts peak-to-peak, and is controlled by R164 which adjusts the plate voltage on V161. The output is coupled through a step-up transformer to the high-voltage rectifier.

f. High-Voltage Rectifier and Multiplier. This circuit consists of a network of selenium rectifiers and charging capacitors which rectify and multiply the 2,000-volt ac input from the oscillator. The 14,000-volt dc output is applied to the high-voltage anode in the cathode-ray tube.

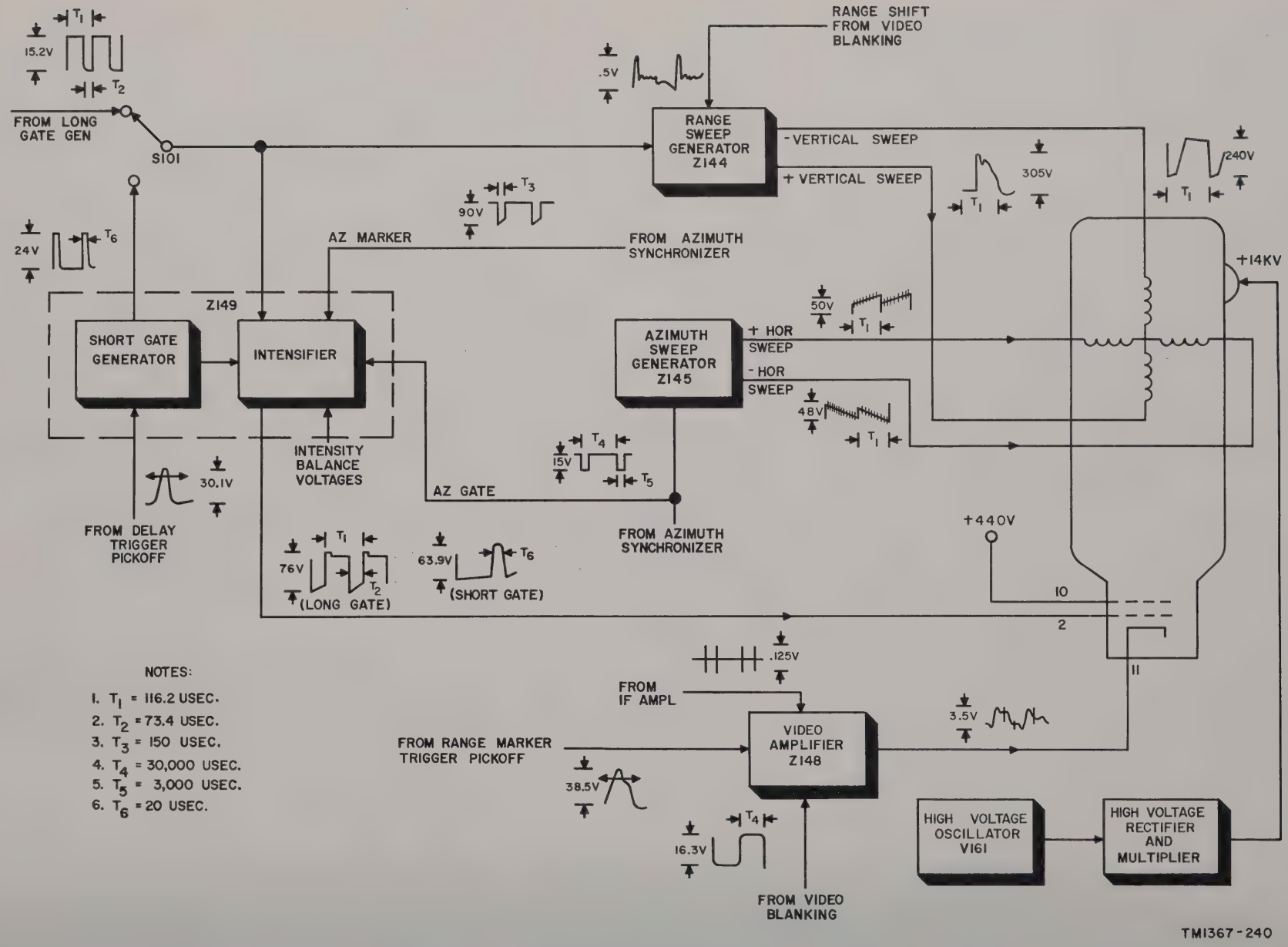
g. Cathode-Ray Tube V101. The cathode-ray tube is a high resolution tube with electromagnetic deflection and focusing. The input from the intensifier circuit to the control grid turns the electron beam on during the sweep period. Inputs from the range and azimuth sweep circuits to the deflection coils cause the electron beam to sweep the screen. The output from the video amplifier to the cathode of the crt intensity modulates the beam and produces the two intensified lines which indicate range and azimuth of the target.

105. Computing System (fig. 88)

a. Elevation Subassembly. The elevation subassembly uses information received from the setting of the LOWER BEAM ELEVATION adjustment to produce a reading on the associated counter. The same data from the antenna elevation synchro is used to derive electrical analogs for the elevations of the upper and lower beams. These analogs are fed to the range subassembly.

b. Range Subassembly. The range subassembly controls the B-scope range strobe lines which correspond to the ranges of the upper and lower beams. The settings of the two controls, LOWER BEAM RANGE AND △ RANGE, produce the weapon range reading on the RANGE counter. In addition, these control settings are used to obtain the difference in height between the two beam intercepts. This difference is fed to the *C* subassembly for multiplication by the circuit constant, and then returned to the range subassembly. Electrical analogs of the weapon range are produced here and sent to the azimuth subassembly.

c. Azimuth Subassembly. The azimuth subassembly uses the LOWER BEAM AZIMUTH and △ AZIMUTH controls to move the azimuth strobe line on the B-scope. This strobe line corresponds first to the lower beam and then to the upper beam azimuth. The settings of the two controls are combined with information from the antenna azimuth synchros and



NOTES:

1. T_1 = 116.2 USEC.
2. T_2 = 73.4 USEC.
3. T_3 = 150 USEC.
4. T_4 = 30,000 USEC.
5. T_5 = 3,000 USEC.
6. T_6 = 20 USEC.

Figure 87. Indicating system, simplified block diagram.

the azimuth orient motor to produce the weapon azimuth reading on the AZIMUTH counter. In addtion, the subassembly combines the value of weapon azimuth with weapon range to produce rectangular map coordinates of the range, and sends this information to the coordinate subassemblies.

d. Coordinate Subassemblies. The first coordinate subassembly combines the easting component of weapon range, derived from the azimuth resolver, with radar easting. The other coordinate subassembly combines the northing component of weapon range, derived from the azimuth resolver, with radar northing. The weapon easting and northing readings thus produced on the WEAPON LOCATION counters are the map coordinates.

e. Height Subassembly. The height subassembly receives information from the setting of the RADAR HEIGHT adjustment and the setting of the weapon HEIGHT control. The subassembly produces corresponding counter readings from this data, and also derives an electrical analog of the difference in the two heights. The electrical analog is sent to a servo amplifier and combined with data from the range and *C* subassemblies. The resultant output is fed to the *C* subassembly and used to derive a more accurate computation of weapon position.

f. Time Subassembly. The time subassembly receives information from the setting of the time control and produces a reading on the △ TIME counter. This reading corresponds to the △ time control and produces a reading on the △ cepts. In addition, the control setting information is combined with data from the *C* subassembly in an isolation amplifier. The output is fed back to the *C* subassembly and used to derive a more accurate computation of weapon position.

g. C Subassembly. The *C* subassembly uses data received from the elevation, range, height, and time subassemblies to obtain the extrapolation constant necessary for azimuth and range computations. This constant is then used to produce automatic potentiometer action which multiplies the range and azimuth differences between the two beam intercepts by the constant *C*.

h. Amplifiers.

(1) *Isolation amplifiers.* The isolation amplifiers are used to add the electrical analogs, and also serve to isolate from each other the circuits which produce the analogs.

(2) *Servo amplifiers.* The vacuum tube servo amplifiers, together with the magnetic amplifiers, control power for the synchro motors which activate the gear trains. One of the servo amplifiers (AR927A) also serves as a mixer to produce the height correction factor.

(3) *Booster amplifier.* The booster amplifier controls power for a resolver (control transformer) in the azimuth subassembly.

(4) *Cutover amplifier.* The dual speed cutover amplifier, mounted on the same chassis as the booster amplifier, acts as a data switch for the antenna azimuth synchros. During coarse positioning of the antenna, the amplifier builds up the output of the one-speed (6,400 mils/rev) azimuth synchro and sends this output to a servo amplifier. Here it is amplified again and fed to the azimuth subassembly at a sufficient level to override the output from the nine-speed (720 mils/rev) synchro. During fine postioning of the antenna, the cutover amplifier does not operate and the output from the nine-speed synchro controls the signal fed to the azimuth subassembly.

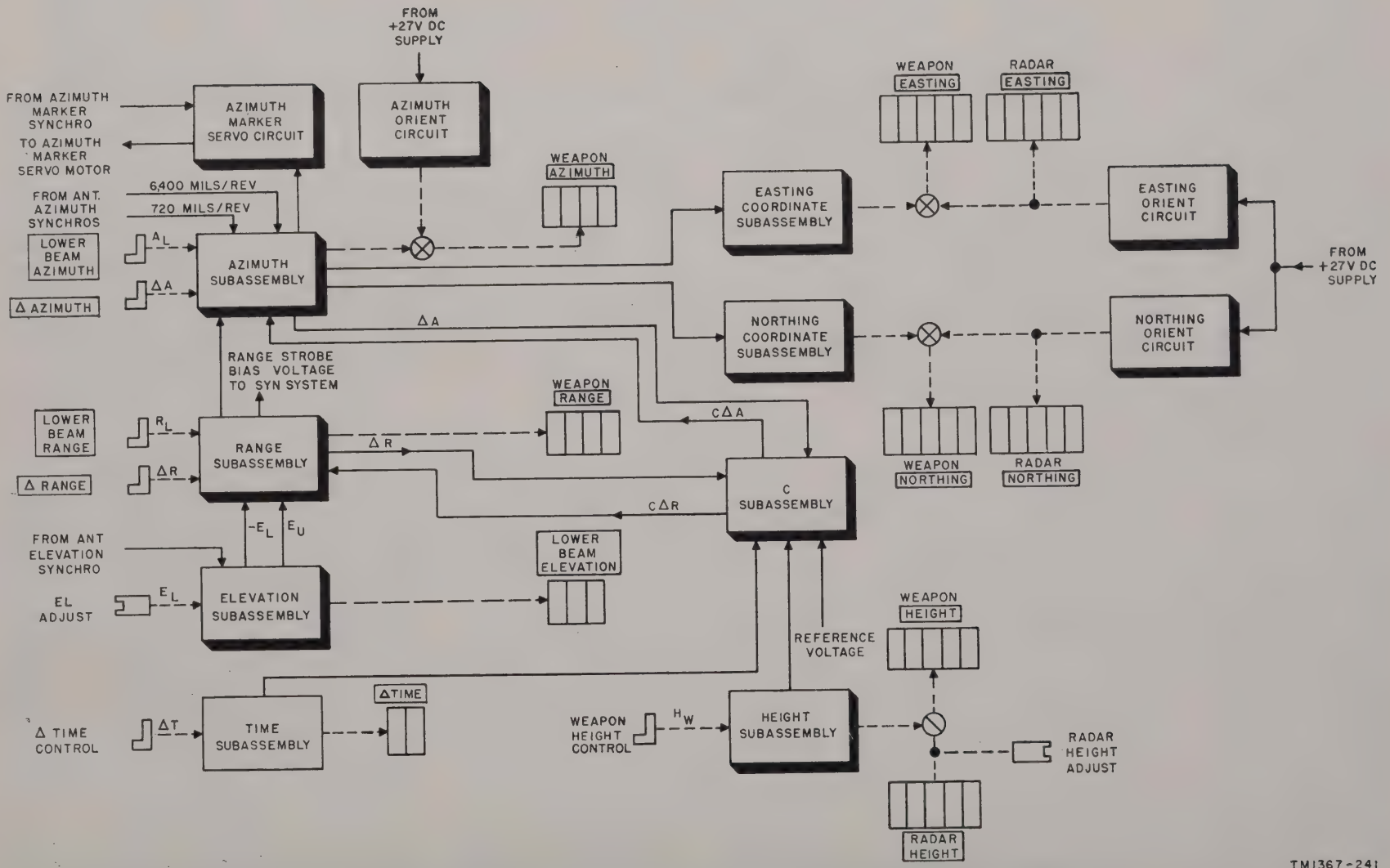


Figure 88. Computing system, simplified block diagram.

106. Antenna Positioning System (fig. 89)

The antenna positioning system consists of the elevation and azimuth switches, elevation and azimuth drive assemblies, antenna pedestal, elevation synchro B3005, and azimuth synchros B3001 and B3002.

a. Elevation Drive Assembly. The elevation drive assembly comprises the 27-volt relays K1501 and K1502 (located in the receiver compartment) and elevation drive motor B3004 with its associated elevation actuators. The motor and acuators are mounted on the upper portion of the pedestal. The elevation actuators are pivoted at the pedestal and at the antenna support structure. The drive motor is mounted between the actuators. When ELEVATION switch S655 is pressed to either the RAISE or LOWER position, the two relays operate and voltage is applied to drive motor B3004. The motor in turn drives the elevation actuators which extend or retract to tilt the reflector as desired. A total of 300 mils of elevation tilting is available. With the lower beam in a horizontal position, this 300 mils of tilt is 200 mils above the horizontal and 100 mils below the horizontal. The extent of elevation tilting is fixed by limit switches in the drive motor.

b. Elevation Synchro. Elevation synchro B3005 is located below the scanner drive motor and mounted on the antenna support structure. As the reflector is tilted in elevation, the synchro is actuated and the resulting signal is electrically coupled to the computer LOWER BEAM ELEVATION counter. At the same time, the elevation reading is mechanically connected to the elevation counter on the antenna.

c. Azimuth Drive Assembly. The azimuth drive assembly comprises the 27-volt relays K3001 and K3002, and azimuth drive motor B3003 with its associated azimuth gear train. When AZIMUTH switch S656 is pressed to either the CCW or CW position, the two relays operate and voltage is applied to drive motor B3003. The motor drives the gear train assembly which in turn engages the large ring gear in the upper portion of the pedestal and the pedestal is turned in azimuth.

d. Antenna Pedestal AB–486/MPQ–4A. The antenna pedestal consists of a stationary lower section and a rotating upper section. The stationary portion mounts two external castings, one containing the azimuth drive gear train and the other the azimuth synchro drive assembly. The azimuth drive gear train meshes with the large ring gear which is attached to the underside of the pedestal rotating section. The top side of the rotating section mounts the supporting structure for the scanner and reflector. As the pedestal is turned in azimuth by the interaction between the ring gear and the azimuth drive gear train, the scanner and reflector are also rotated. A complete circle of 6,400 mils is covered by this revolution. The speed of rotation in azimuth is 1 to 2 revolutions per minute.

e. Azimuth Synchros. Azimuth synchros B3001 and B3002 with their associated gear train are contained in a metal casting on the stationary portion of the pedestal. The synchro gear train is meshed with the large ring gear on the rotating portion of the pedestal so that the synchros are actuated when the antenna is turned in azimuth. The resulting azimuth data is electrically transmitted to the computer where it is displayed on the AZIMUTH counter. This information is also mechanically coupled to the antenna azimuth counter. Azimuth synchro B3001, a 1 to 1 ratio generator, operates at 6,400 miles per revolution and serves as a coarse positioner of the computer AZIMUTH counter. Azimuth synchro B3002, a 9 to 1 ratio generator, operates at 720 miles per revolution and provides the fine positioning for the computer counter.

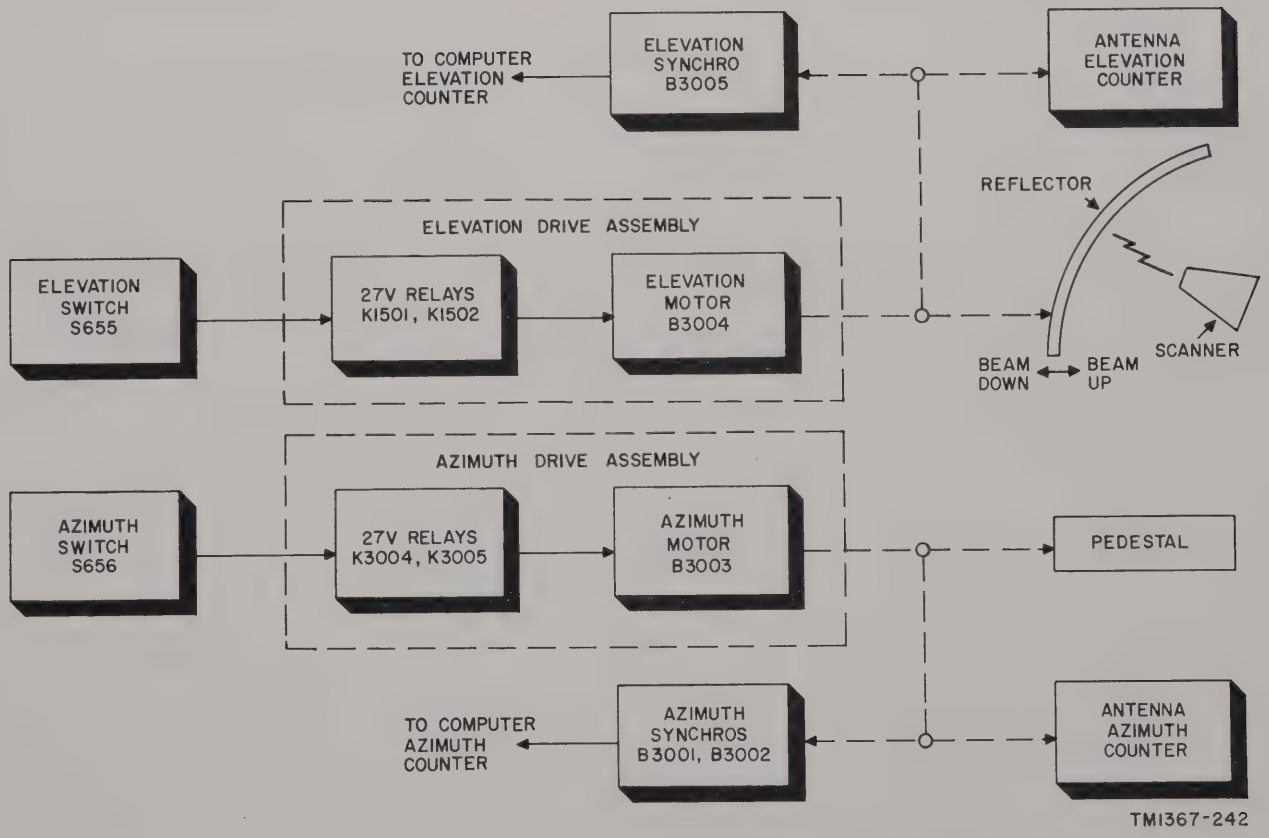


Figure 89. Antenna positioning system, simplified block diagram.

107. Dc Power Supplies System
(fig. 90)

The radar set includes two dc power supply assemblies: Control-Power Supply C–2014/MPQ–4A for the control-indicator group and Power Supply PP–1588/MPQ–4A for the receiver-transmitter group.

a. Control-Power Supply C–2014/MPQ–4A. The control-power supply provides +440 volts, +220 volts, —220 volts, and +27 volts.

(1) *+440-volt supply.* The +440-volt supply is used only in the indicator. The power supply circuit furnishes plate and screen grid voltages to timing sweep generator Z102 and screen grid voltage to the crt. The +440 volts are also applied through one of the vertical deflection coils to the plate of V4405 in range sweep generator Z144.

(2) *+220-volt supply.* The power supply circuit furnishes plate and screen grid voltages to all stages in the indicator. In the computer, the +220 volts are applied as plate voltage to the booster and isolation amplifiers. This supply is also used in the computer for the range subassembly potentiometer which generates the range strobe line.

(3) *—220-volt supply.* This power supply circuit furnishes cathode and grid voltages to various stages in the indicator. It also supplies plate voltages for clamping tubes V4402B and V4501B and for comparator tube V401 in the indicator.

(4) *+27-volt supply.* The +27-volt supply is used to energize the system control circuit.

b. Power Supply PP–1588/MPQ–4A. The low-voltage power supply provides +300 volts, +150 volts, —300 volts, and a keep-alive voltage.

(1) *+300-volt supply.* This power supply circuit furnishes plate and screen grid voltage to the stc and afc assemblies in the receiver, and to the trigger amplifier in the transmitter. The +300 volts are also used as the beam voltage for the klystron.

(2) *+150-volt supply.* This power supply circuit furnishes plate and screen grid voltages to the IF amplifier and to the afc assembly.

(3) *—300-volt supply.* This power supply circuit furnishes a grid voltage to the stc assembly, and operating tube voltages to the afc assembly.

(4) *Keep-alive voltage supply.* This portion of the power supply furnishes approximately 750 volts to the TR tube in the duplexer.

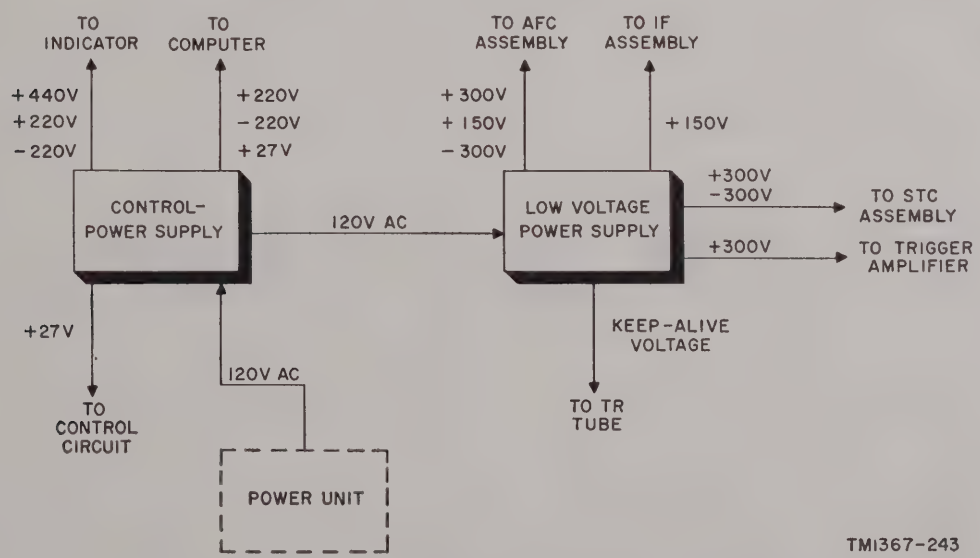


Figure 90. Dc power supplies system, simplified block diagram.

108. Dehydrating System
(fig. 91)

a. Electric Desiccant Dehydrator HD–264/MPQ–4A supplies dry air at a pressure of 12 psi to the waveguide section of the radar set.

b. Push-button switch S3301 on the dehydrator is mechanically actuated when the air intake and filter vent on the front panel is opened. Air is drawn through the filter into the motor compressor, where it is compressed, and then passes to the relief valves. The first pressure relief valve is normally closed and opens when the pressure reaches 15 psi. It serves as a safety feature in the dehydrating system. The second pressure relief valve is preset to open at 12 psi and operates to regulate the pressure of the available air at 12 psi. Air released from this valve is in excess of that required for proper operation of the radar set. A needle valve, consisting of a small adjustable opening, is located between the two relief valves. It is used to reduce pressure pulsations in the output of the compressor and thus prolong the life of the spring in the 12 psi relief valve. The needle valve is present and requires no further adjustment.

c. From the 12 psi relief valve, the air passes through a ball check valve to the desiccant chambers. The check valve prevents moisture from entering the desiccant chambers when no air is required by the waveguide and the 12 psi relief valve is open. The two desiccant chambers, connected in series, contain silica gel which absorbs all moisture present in the air. When the silica gel becomes saturated, as indicated by the dry air indicator, the desiccant chambers may be replaced (par. 87).

d. From the desiccant chambers, the air passes through a pressure gage, filter assembly, and dry air indicator into the waveguide. The pressure gage indicates the pressure in the waveguide and may be observed through the flange port on the front panel of the dehydrator. The filter assembly consists of a felt dust pad held between two brass screens and is designed to keep all dust and foreign particles from entering the waveguide. The dry air indicator is a small chamber filled with silica gel and equipped with a window through which the color of the silica gel may be observed. The silica gel will be blue to indicate normal operation, and pink when the silica gel is saturated.

e. Pressure switch S1101 is located at the other end of the waveguide in the receiver-transmitter cabinet. This switch will automatically shut off power to the magnetron when the air pressure falls below 8 psi.

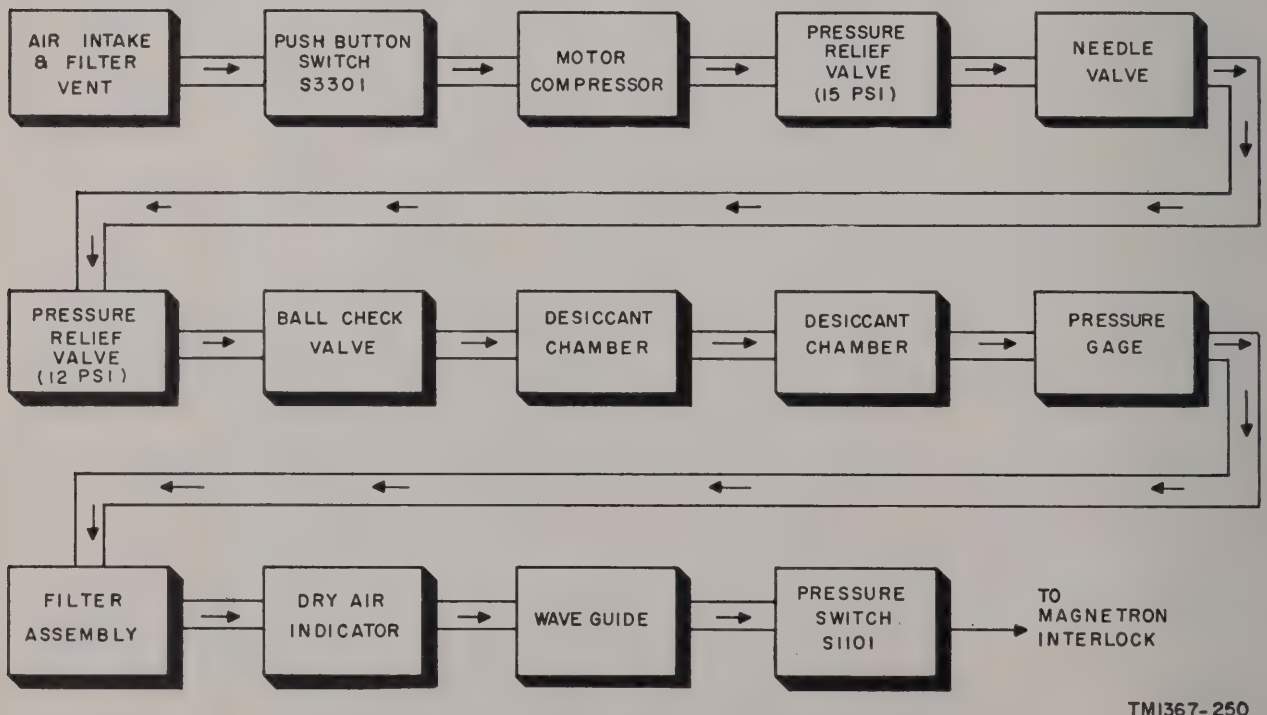


Figure 91. Dehydrating system, simplified block diagram.

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

109. Disassembly of Equipment for Transport

a. Initial Steps.

(1) On the control-power supply panel, press the ELEVATION switch to RAISE or LOWER until the computer LOWER BEAM ELEVATION counter reads between 0 and 50 mils.

(2) Press the STOP button.

(3) Turn the MAIN POWER switch to OFF.

(4) Press the POWER UNIT switch to STOP.

(5) Close and secure the two vent panels on the control-indicator cabinet, the three vent panels on the receiver-transmitter cabinet, and the vent panel on the dehydrator. Replace the vent caps on each end of the scanner.

b. Cables.

(1) Remove power cable W701 connected between the control-indicator group and the power unit. Replace the cable on Cable Reel RC–413/MPQ–4 on the power unit trailer (fig. 6).

(2) If the equipment is in remote operation, remove remote cable W703 connected between the control-indicator group and cable W702. Replace the cable on Cable Reel RC–419/MPQ–4 on the power unit trailer (fig. 6).

(3) Disconnect cable W711 from jack J1004 on the control-indicator group. Stow the cable in the intake blower assembly in the operators' shelter.

(4) Disconnect W730 from jack J1006 on the control-indicator group. Stow the cable in the intake blower assembly.

(5) Disconnect cable W727 between the intake and exhaust blower assemblies in the operators' shelter. Stow the cable in the exhaust blower assembly.

c. Disassembly of Operators' Shelter.

(1) Close the inside and outside covers on both blower assemblies.

(2) Unclamp the two blower assemblies and replace them in the power unit trailer (fig. 6).

(3) Remove the eight ground stakes and web straps which moor the shelter to the ground (6, fig. 15).

(4) Unfasten the canvas walls and fold for stowage.

(5) Loosen the two lock studs which secure the blower mounting plates to the equipment picture frame (5, fig. 15). Retract the entrance-side legs. Lift off the transit case and place it on the ground upside down (4, fig. 15). Remove the ground pads from the entrance-side legs.

(6) Unlock the entrance-side legs by removing the two leg braces (4, fig. 15) and fold the legs into the transit case. Replace the braces and ground pads in the case (2, fig. 15).

(7) Unlock the blower mounting frames by removing the leg braces and fold the frames into the case. Replace the leg braces in their stowed position in the case.

(8) Remove the rear outrigger support brace, loosen the two $\frac{3}{8}$–16 eyebolts, and unlock the nine latches that secure the equipment picture frame to the control-indicator cabinet (3, fig. 15). Stow the frame in the transit case. Tighten down the two eyebolts.

(9) Remove the indicator transit cover from the top of the cabinet and secure the cover to the cabinet.

(10) Replace the ground stakes, web straps, and picture frame in the transit case (2, fig. 15). Place the folded canvas over these items in the transit case.

(11) Close and latch the transit case.

(12) Transport the case to power unit trailer and secure it in position with the straps provided (1, fig. 15).

d. Control-Indicator Group OA–1256/MPQ–4A. If the control-indicator group has been operating in a remote position, proceed as follows:

(1) Pull out the pip pins that secure the control-indicator cabinet to the remoting stand.

(2) Extend the two carrying handles to their transport position.

(3) Lift the cabinet by these handles and carry it to the antenna trailer. Four men are required for this operation.

(4) Bolt the cabinet in position on the antenna trailer.

e. Disassembly of Remoting Stand.

(1) Place the stand upside down on the ground.

(2) Pull out the retainer pin which holds each leg in its socket and remove each of the four legs.

(3) Release the leg-stowing clamp by pulling out the retainer pin.

(4) Replace the four legs in their stowed position and secure the clamp by pushing the retainer pin back in place. Stow the four leg-retaining pins in the holes provided on the top of the stand.

(5) Replace the remoting stand on the power unit trailer (fig. 6).

f. Disassembly of Operators' Seats (Remote).

(1) Lift the seats free of supports and place them on the ground.

(2) Replace the two seat supports on the power unit trailer (fig. 6).

(3) Replace the two operators' seats in their forward position on the antenna trailer.

g. Disassembly of Operators' Seats (Local).

(1) Remove the seats from the support arms by lifting them straight up from their sockets.

(2) Swing the support arms into their stowed position on the rear jack assembly of the antenna trailer.

(3) Replace the two seats in their stowed position on the front end of the antenna trailer.

110. Securing Antenna

a. Release the reflector by loosening the locking pins and disengaging the locking screws on the bottom of the reflector support beams (fig. 14).

b. Lower the reflector by turning the handcranks attached to the elevation actuators (fig. 14). Turn the cranks until the reflector rests on the stowing bars.

c. Secure the reflector with the clamps provided (fig. 13).

111. Preparing Antenna Trailer for Transit (fig. 92).

a. Remove the ground stake from the ground and recoil the cable. Clamp the stake in its stowed position on the trailer (fig. 12).

b. Replace the waterproof cover on the spirit level assembly.

c. Rotate both wheel fenders inward to their transit position and secure them with locking pins.

d. Place the azimuth stowlock (fig. 1) in its engaged position.

e. Put the azimuth hand wheel (fig. 11) in the transit (midway) position.

f. Retract the jackscrew on the rear outrigger arm by means of the ratchet handcrank (fig. 10).

g. Remove the rear outrigger support brace from the trailer frame. Loosen the two locking screws on the jack and swing the support brace into its transit position (fig. 9). Tighten the jack locking screws.

h. Release the rear outrigger arm by unscrewing the operational locking screws and loosening the pivot screw on each side of the trailer. Rase the outrigger arm to a stowed position. Reassemble the arm with the transit locking screws provided (fig. 9). Tighten the pivot screw.

i. Retract the jack screws on the right and left outrigger arms by means of the associated handcranks (fig. 8).

j. Unscrew the operational locking screws which secure the outrigger arms to the trailer frame (fig. 8). Raise the outrigger arms and swing them into the stowed position on the trailer. Secure the arms to the support rods with the locking pins provided (fig. 7).

k. Replace the three outrigger pads in the trailer on the curb-side fender support.

l. After visually inspecting the trailer to see that everything is secure, place the tarpaulin over the reflector and scanner.

m. Couple the trailer to the prime mover by means of the lunette eye. Connect the safety chains, air hose coupling, and signal cable to the prime mover.

n. Pull out the locking pin on the front-end landing wheel and raise the wheel into its transit position.

o. Release the hand brakes. The antenna trailer is now ready for transit.

Figure 92. Antenna trailer secured for transit.

112. Preparing Power Unit Trailer for Transit
(fig. 93)

a. Make a visual check of the trailer. Use the loading diagram in figure 6 to see that all accessories are stowed and in their proper position.

b. Place the tarpaulin over the power unit.

c. Secure the covers of all gasoline cans.

d. Tie down the tarpaulin on the power unit trailer.

e. Release the support leg at the rear of the trailer and swing it into the transit position.

f. Couple the trailer to the prime mover by means of the lunette eye. Connect the safety chains, air hose coupling, and signal cable to the prime mover.

g. Pull out the locking pin on the front-end landing wheel and raise the wheel into the transit position.

h. Release the handbrakes. The power unit trailer is now ready for transit.

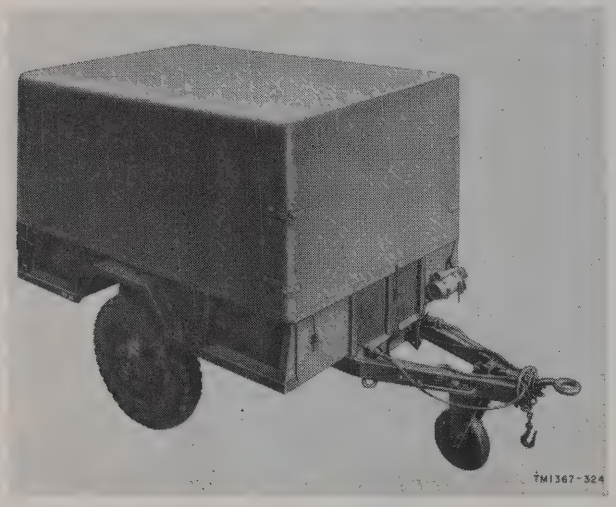


Figure 93. Power unit trailer ready for transit.

113. Repacking for Shipment or Limited Storage

a. Domestic Shipment. When the equipment is to be shipped within the zone of interior, proceed as follows:

(1) Prepare the equipment for transport as outlined in paragraphs 109 through 112.

(2) If the anticipated temperature will be below — 40° F., drain the power unit cooling system. Attach caution tags in appropriate locations regarding the empty cooling system. Refer to TM 5–5264 for further information.

(3) Prepare the power unit trailer for transport as outlined in paragraph 112.

(4) Inspect all fastenings and tarpaulin lashings to make certain that they are secure.

(5) If the tires are to be used, inflate them to 10 per cent above the specified pressure. If the trailers are to be loaded onto flatcars, reduce the tire pressure to ⅔ of the specified pressure.

b. Limited Storage. When the equipment is to be stored for a limited time, use the following procedure:

(1) Check all components, tools, and spare parts to make certain that the equipment is complete and serviceable. Replace unserviceable or missing components.

(2) Process the power unit according to instruction given in TM 5–5264. If the anticipated temperature will be below — 40° F., drain the power unit cooling system and attach caution tags in appropriate locations regarding the empty cooling system.

(3) Clean any grease or corrosion from all electrical connectors. Attach connector caps. Wrap all connectors in two layers of greaseproof barrier material.

(4) Drain all gasoline cans and allow all gasoline to evaporate. Ventilate the gasoline cans in a manner approved for storage.

(5) Carefully place all spare parts and tools in their transit cases, or secure them in their designated places. Pad them with corrugated fiberboard to prevent movement. Fasten all covers securely.

(6) Follow the procedure outlined in paragraphs 109 through 112 to place the equipment in stowed condition.

(7) In storage, the weight of both trailers should be lifted off the wheels. Reduce tire pressure to two-thirds of specified pressure.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

114. General

The demolition procedures outlined in paragraph 115 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

115. Methods of Destruction

Use any or all methods described below to destroy the equipment.

a. Smash. Smash the magnetron, klystron, waveguides, modulator transmitter, indicator CRT, computer, all tubes, meters, variable capacitors, relays, spare parts, and power unit. Use sledges, axes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut all cords, cables, and wiring. Use axes, handaxes, or machetes.

c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals. Use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panels, cabinets, and chassis.

e. Explosives. Explosives are necessary to destroy the antenna group. Use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts, in slit trenches, fox holes, or other holes, or throw them into streams.

[AG 413.44 (4 Apr 58)]

By Order of *Wilber M. Brucker*, Secretary of the Army:

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General ,United States Army,
Chief of Staff.

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HERBERT M. JONES,
Major General, United States Army,
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Sig Fld Maint Shops
Sig Lab
Mil Dist
USA Corps (Res)
Sectors, USA Corps (Res)
JBUSMC

Units org under fol TOE:

11–7
11–16
11–57
11–127
11–128
11–500 (AA–AE)
11–557
11–587
11–592
11–597

NG: State AG; units—same as Active Army.
USAR: None.
For explanation of abbreviations used, see AR 320–50.

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